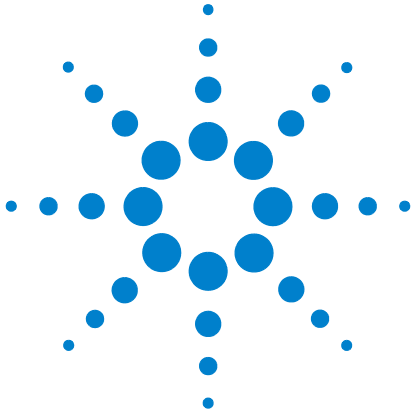

Agilent LTM Series II Rapid Heating/Cooling System for Agilent 7890A GC

User Guide

Agilent Technologies

Notices

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Manual Part Number

G6678-90020

Edition

First edition, April 2011

Printed in USA

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CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Contents

8 Installation

1 Introduction

This section introduces the Agilent LTM Series II Rapid Heating/Cooling System for 7890A GCs.

Overview

The Agilent Low Thermal Mass Series II Rapid Heating/Cooling System for Agilent 7890A GC (LTM) is designed to enhance the column temperature programming capabilities of the Agilent 7890A Gas Chromatograph (GC). The LTM oven door accepts up to four LTM column modules, each of which contains a GC capillary column that can be independently temperature programmed. These column modules provide a fast ramp temperature programming capability compared to the standard GC oven. The column modules interface through the existing oven to the GC's existing samplers, inlets, detectors, and other accessories.

The Agilent LTM system achieves its ramp rates by packaging a capillary GC column into the LTM column module. Within a module, the GC column is formed into packed coils using resistively heated wire and a temperature sensor. The high efficiency of this proprietary design provides fast heating and cooling of the GC columns with greatly reduced power requirements compared to a conventional GC oven. Mounting the modules outside the conventional GC oven allows them to cool rapidly with ambient air. The GC oven heats the columns which connect the LTM column module to the inlet or detector. This system provides great flexibility to configure the GC oven in different ways using the available inlet, detector, and capillary flow technology (CFT) flow-splitting options.

The LTM is compatible with Agilent 7890A GCs with firmware revision A.01.12.1 or greater.

LTM System Components

The LTM system consists of the major components listed below

LTM oven door

The main component of the LTM System is the LTM oven door. See Figure 1. This door contains:

- The electronics which control the LTM column module temperatures
- The LTM column modules
- The cooling fans
- The unions and mounting hardware for connecting the LTM column modules to the other GC components

Figure 1 LTM oven door as installed on a 7890A GC

Power supply

The LTM system requires 1 or 2 separate power supplies, depending on the option ordered. Two modules can share one power supply. However, when using 5-inch column modules, optional faster heating requires use of two power supplies. See Figure 2.

Figure 2 LTM power supply (power cord not shown)

Transfer line modules

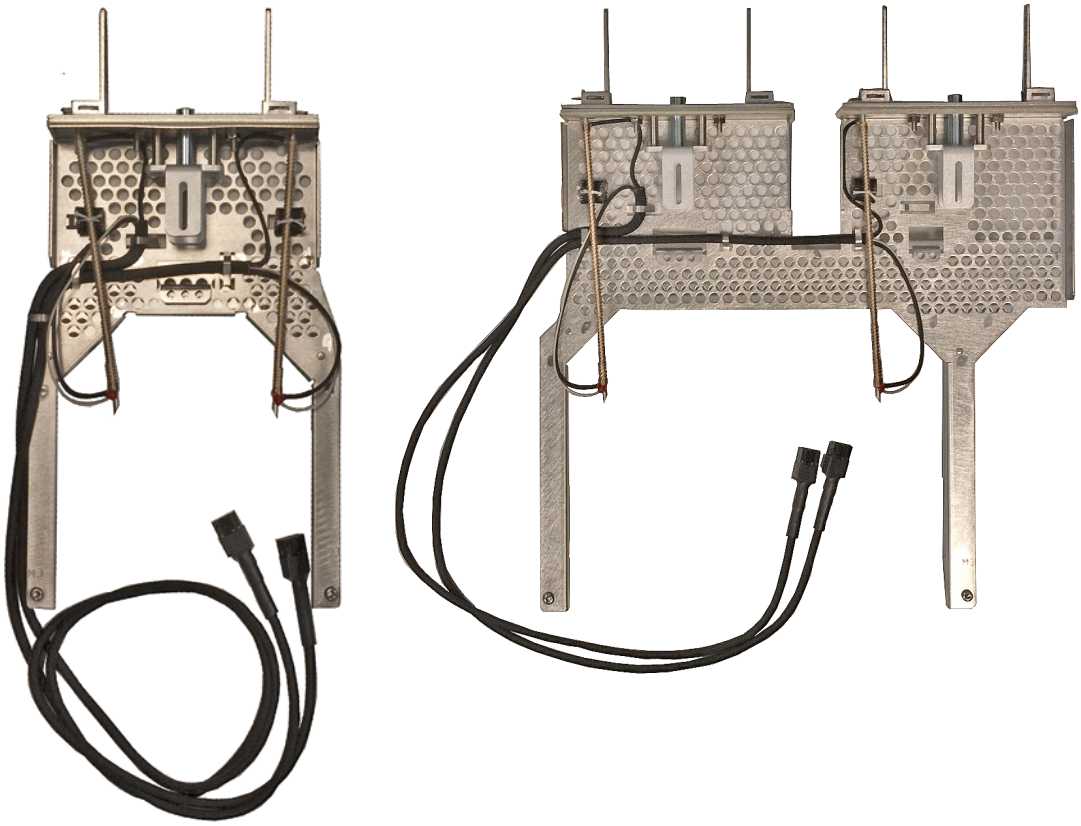
The transfer line module provides the interface between the column module and the GC oven. The transfer line module has two heated tubes (transfer lines) through which the column leads pass from the LTM column module into the oven. These transfer lines are temperature programmable to prevent cold spots in the sample path between the GC oven and the LTM column module. Each LTM column module attaches to a transfer line module, and the resulting module assembly inserts into slots in the LTM oven door. The transfer line modules come in two sizes, one for each of the two sizes of LTM column modules. See Figure 3.

NOTE

The current transfer line module and LTM column module design uses guides in the column module to correctly position the column module onto the transfer line module. The column module secures into the transfer line module using two screws.

The earlier design uses two clamp brackets to attach the LTM column module to the transfer line module.

The new, Series II design transfer line module can mount older, clamp-based column modules. However, you cannot use a new column module in an older transfer line module.



For a single 3-inch module

For a single 5-inch module

Figure 3 LTM transfer line modules

Column modules

A column module contains the analytical column, column heater, and temperature sensor. Column modules are currently available in two sizes (see Figure 4.):

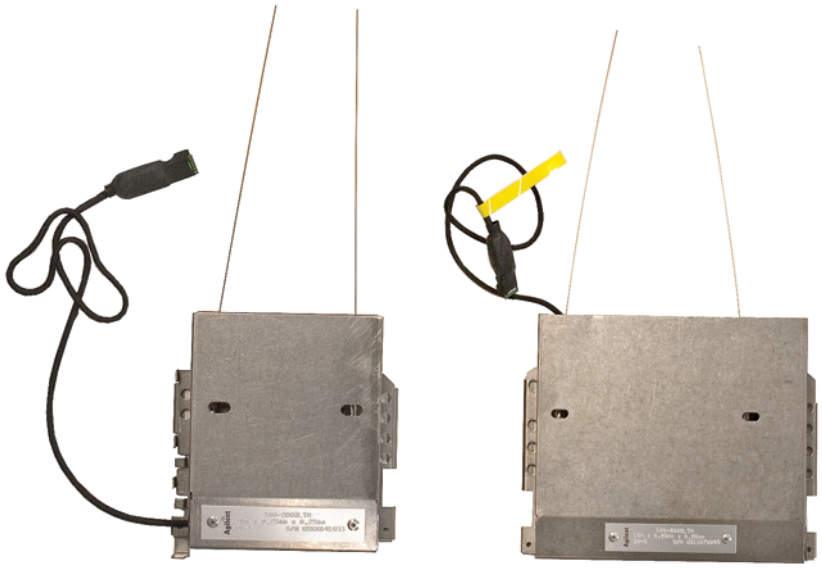
- A standard format that accommodates a 12.7-cm (5-inch) coil size.
- A small format that accommodates a 7.6-cm (3-inch) coil size.

The standard format is required for GC capillary column bore sizes greater than 0.32 mm, and is strongly recommended for most GC columns having Porous Layer Open Tubular (PLOT) phases. The standard format consumes slightly more power, but provides faster cooling speeds than the small format and is usually the preferred format for this reason. However, the standard format uses two adjacent slots in the LTM oven door. Because of this, simultaneous module

operation with standard format is limited to two modules in the LTM system (one on top and one on bottom).

Module sizes can be mixed so that one standard format module can be used with either one or two small format modules.

Column modules are designed to mount onto the transfer line module, then this assembly slides into a predetermined position and screws in place.



3 inch LTM column module 5 inch LTM column module

Figure 4 LTM column modules

Fan bracket

The fan bracket contains the fan or fans which cool the column module/transfer line module assembly. See Figure 5. Two sizes of fan bracket are available. The fan bracket required depends on the transfer line module (and column module) used. The fan brackets attach to the front of the LTM oven door, below the slots for the transfer line/column module assemblies. An indicating LED in the fan bracket displays diagnostic information. All transfer line module/column modules are compatible with all series of fan brackets of matching size, but some early model fan brackets do not provide the indicating LED.

Figure 5 Fan brackets, for 3-inch and 5-inch modules (not to scale)

Gasket

Insulation gaskets provide a tight seal to prevent heat from leaking through the LTM oven door, resulting in unwanted heating of the module components. See Figure 6. These gaskets are re-usable, but do age with use at high temperatures and should be replaced when they become too fragile for reuse. Use two gaskets with the 5-inch transfer line module.

Figure 6 Gasket

Union brackets

The union brackets mount a union on the ends of the transfer line module. The unions connect the LTM column to the column segments that lead to the GC inlet, detector, or other components.

Agilent recommends using the CFT Ultimate unions and brackets supplied in the transfer line module kit. See Figure 7. The CFT unions provide reusable fittings that should not require retightening after thermal cycling.

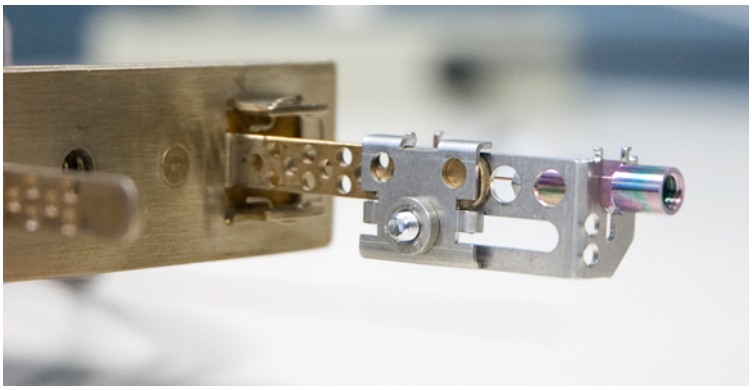


Figure 7 CFT union and bracket

The CFT Ultimate union ferrules are available for the capillary column sizes listed in Table 1.

Table 1 SilTite ferrules for Agilent CFT Ultimate unions

Fused silica capillary column od	Recommended Ferrule
0.4 mm (typically 0.25 mm or smaller id)	5188-5361 (5/pk)
0.5 mm (typically 0.32 mm id)	5188-5362 (5/pk)
0.8 mm (typically 0.53 mm id)	5188-5363 (5/pk)

In addition to the CFT union, the Valco Ultra Low Mass (ULM) unions available with older column modules will also work. See Figure 8. The ULM unions use re-usable ferrules and require no special tools. The ULM unions are integrated with the bracket.

Figure 8 Union bracket with Valco ULM union

We recommend the Valco re-usable ferrules listed in Table 2 for use with the ULM unions.

Table 2 Valco re-usable ferrules for use with ULM unions

Fused silica capillary column od	Recommended Ferrule
0.4 mm (typically 0.25 mm or smaller id)	5190-1437 (5/pk)
0.5 mm (typically 0.32 mm id)	5190-1438 (5/pk)
0.8 mm (typically 0.53 mm id)	5190-1439 (5/pk)

1 Introduction

2 Safety

This sections describes the safety requirements for installation and operating the Low Thermal Mass (LTM) Series II system on an Agilent GC. It also provides regulatory and related information.

Important Safety Warnings

Before using the Agilent LTM system the user must be familiar with the operation and safety of the Agilent 7890A GC on which the LTM system is installed. This information can be found on the Agilent GC and GC/MS Hardware User Information & Instrument Utilities software disks that ship with the LTM II product and the Agilent 7890A GC.

Some parts of the LTM system carry dangerous voltages

If the LTM system is connected to a power source potentially dangerous voltages exist on:

- The power cable between the LTM power supply and the line power, the LTM power supply, the wiring from the LTM power supply to the LTM electronics enclosure, everywhere within the electronics enclosure, and the wiring between the LTM electronics enclosure and the column modules.

WARNING **The electronics and power supply are shielded by covers and the external wiring by insulated coverings. With the covers in place, it should be difficult to accidentally make contact with dangerous voltages. Unless specifically instructed to, never remove a cover unless the LTM power supply is disconnected from its power source.**

WARNING **If the power cord insulation, or insulation on any of the other external cables is frayed or worn, the cord or cable must be replaced. Contact your Agilent service representative.**

Electrostatic discharge is a threat to GC electronics

The printed circuit (PC) boards in the LTM system can be damaged by electrostatic discharge. Do not touch any of the boards unless it is absolutely necessary. If you must handle them, wear a grounded wrist strap and take other antistatic precautions. Wear a grounded wrist strap any time you must remove the LTM electronics enclosure cover.

LTM parts are dangerously hot

WARNING **Many parts of the externally mounted LTM column module and the interior of the LTM oven door including the column unions operate at temperatures high enough to cause serious burns.**

You should always cool the LTM system column modules and the GC oven and oven accessories to room temperature before working on them. They will cool faster if you first set the temperature of the heated zone to room temperature. Turn the GC and the LTM system zones off after they have reached a safe setpoint. If you must perform maintenance on hot parts, use a wrench and wear thermally protective gloves. Whenever possible, cool the part of the instrument that you will be maintaining before you begin working on it.

WARNING **The oven door insulation around the interface between the GC oven and LTM column module is made of refractory ceramic fibers. To avoid inhaling fiber particles, we recommend the following safety procedures: ventilate your work area; wear long sleeves, gloves, safety glasses, and a disposable dust/mist respirator; dispose of insulation in a sealed plastic bag; wash your hands with mild soap and cold water after handling the insulation.**

Hydrogen Safety

Please refer to the Agilent 7890A Gas Chromatogram Safety Manual for important information regarding hydrogen safety.

WARNING **Hydrogen is flammable. Leaks, when confined in an enclosed space, may create a fire or explosion hazard.**

Description of Fuses

The LTM system does not contain any fuses or batteries. For fuses and batteries located in the GC, refer to the GC documentation.

Safety and Regulatory Certifications

The Agilent LTM system conforms to the following safety standards:

- Canadian Standards Association (CSA): C22.2 No. 1010.1 Second Edition
- International Electrotechnical Commission (IEC): 61010-1
- EuroNorm (EN): 61010-1 Second Edition
- CSA/Nationally Recognized Test Laboratory (NRTL): US 61010-1 Second Edition

Conforms to the following regulations on electromagnetic compatibility (EMC) and radio frequency interference (RFI).

- IEC/EN 61326
- Declaration of Conformity available

Instructions for Disposal of Waste Equipment by Users in the European Union. This symbol on the product or its packaging indicates that this product must not be disposed of with other waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city recycling office or the dealer from whom you originally purchased the product.

For indoor use only.

Changes or modifications not expressly approved by Agilent Technologies could void the user's authority to operate the equipment.

Information

The Agilent Technologies LTM system meets the following IEC (International Electrotechnical Commission) classifications: Safety Class I, Transient Overvoltage Category

II, Pollution Degree 2.

This unit has been designed and tested in accordance with recognized safety standards and is designed for use indoors in non-classified locations. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired. Whenever the safety protection of the Agilent LTM system has been compromised, disconnect the unit from all power sources and secure the unit against unintended operation.

Refer servicing to qualified service personnel. Substituting parts or performing any unauthorized modification to the instrument may result in a safety hazard.

Symbols

Warnings in the manual or on the instrument must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions violates safety standards of design and the intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

See accompanying instructions for more information.

Indicates a hot surface.

Indicates hazardous voltages.

Indicates earth (ground) terminal.

Indicates potential explosion hazard.

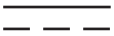
Indicates radioactivity hazard.

Indicates electrostatic discharge hazard.

Indicates a hazard. See the Agilent 7890A GC user documentation for the item labeled.

Indicates that you must not discard this electrical/electronic product in domestic household waste

DC Voltage



AC Voltage

Cleaning

To clean the unit, disconnect the power and wipe down the exterior with a damp, lint-free cloth.

Recycling the Product

For recycling, contact your local Agilent sales office.

3
Column Modules

Please refer to this section when it is necessary to change the column in the LTM system. This chapter explains how to assemble a column module to its transfer line module and how to attach the column to the unions which connect to oven components. It also explains how to attach the module assembly to the LTM oven door and how to make the necessary electrical connections required for temperature control.

Overview

The LTM oven door mounts up to four (depending on size) module assemblies. Each module assembly consists of a column module mounted onto a transfer line module. (See "LTM System Components" for definitions.)

It is important to read through these instructions before attaching a column module to a transfer line module. It is usually more convenient to complete this module assembly on a desktop or table top, rather than at the LTM oven door. The completed module assembly then slips into the LTM oven door for final attachments.

The overall process for installing a column for the LTM system is:

1. Remove the existing column module or cover plate from the LTM oven door.
2. If not present, install the appropriate fan bracket.
3. Install the column module onto the transfer line module.
4. Attach the column ends to unions on the transfer line module.
5. Install the transfer line and column module assembly into the LTM oven door.
6. Connect the in and out column segments from the GC inlet and detector to the transfer line module unions.

There are two sizes available for column modules and their associated transfer line modules. The small format 7.6 cm (3 inch) coil modules attach to a transfer line module using two screws, and the resulting module assembly fits a single slot of the LTM oven door. Figure 9 shows a completed 7.6 cm (3 inch) LTM column and transfer line module assembly.

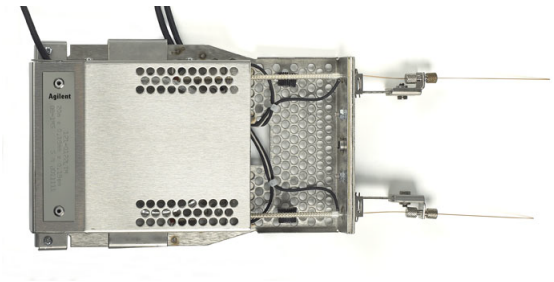


Figure 9 3-inch column module and transfer line module assembly

The standard module size contains a 12.7 cm (5 inch) column coil. This coil size is compatible with delicate PLOT columns and fused silica capillary columns with inner diameter ranging from 0.1 mm to 0.53 mm. It also cools faster because of the larger surface area of the capillary GC column assembly. The transfer line module for the 12.7 cm coil module uses a horizontal pair of slots in the LTM oven door. The standard format size column module slides to a predetermined position and then screws down for easier assembly. Figure 10 shows a completed 12.7 cm (5 inch) coil module assembly.

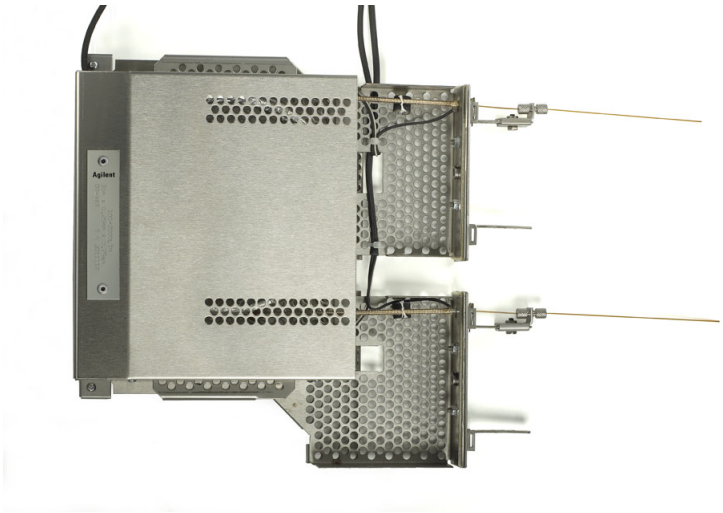


Figure 10 5-inch column module and transfer line module assembly

Please note that older RVM column modules using the screw clamps for attachment are compatible with the newer, clampless transfer line modules, but the clampless column modules are not backwards compatible with the older transfer line modules.

To Attach a CFT Nut and Ferrule to a Capillary Column

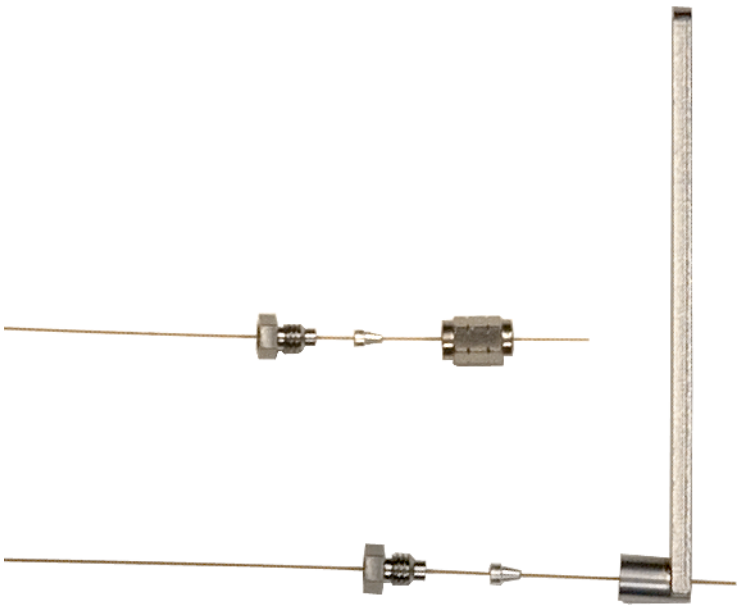
This procedure is used to attach a CFT nut and ferrule to a capillary column prior to installation into a CFT fitting or union. If installing the column ends to the union in a transfer line module, see "To Connect the Column to the CFT Unions" instead.

CAUTION Wear clean, lint-free gloves to prevent contamination of the parts.

1 Gather the following:

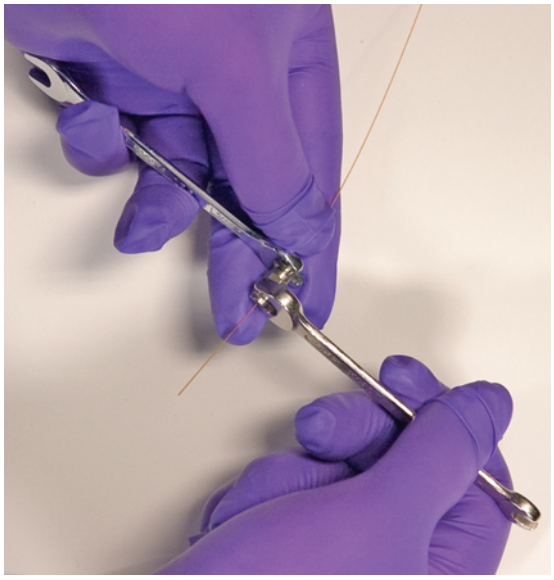
- Swaging nut (G2855-20555) or swaging tool (G2855-60200)
- Internal nut (G2855-20530)
- SilTite ferrule appropriate for the column size (see "Consumables and Replacement Parts")
- Column cutter, wafer (5181-8836, 4/pk)

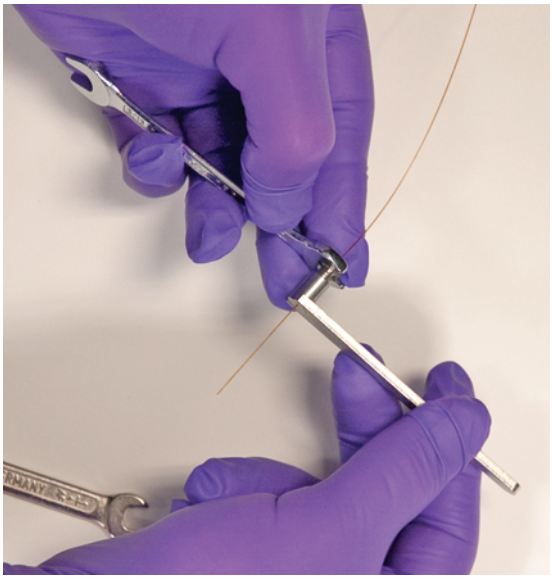
2 Pass the column end through the internal nut and SilTite ferrule leaving approximately 1 cm of fused silica column protruding beyond the ferrule. Thread the swaging nut or swaging tool onto the internal nut with the column protruding.



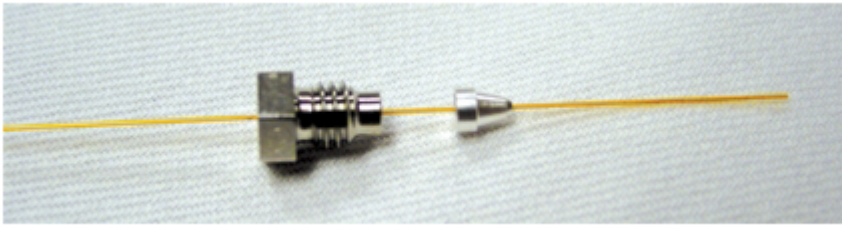
3 Swage the ferrule in place. When the ferrule starts to grip, tighten one of the nuts an additional 45 to 60 degrees (one flat).

- If using the swaging nut: Using two wrenches against each other, tighten the two nuts together a little at a time, occasionally checking to see if the ferrule is gripping the column.
- If using the swaging tool: Using a wrench on the internal nut, tighten the swaging tool against the internal nut a little at a time, occasionally checking to see if the ferrule is gripping the column.





4 Remove the swaging nut or swaging tool.



5 Use a wafer column cutter to trim the column at the small end of the ferrule. See Figure 11.

a Place the wafer on the column, then slide along the column until the wafer rests against the end of the ferrule.

b Tilt the wafer away from the ferrule at an approximate 45 degree angle. (Do not slide it along the column!)

c Score the column and remove the loose end.

This technique will leave approximately 0.3 mm of column extending beyond the ferrule.

- Do not use other column cutting tools. The ceramic wafer helps provide the correct trim length.
- The column cannot extend more than 0.5 mm from the end of the ferrule.
- Check the end of the column with a magnifier. The end of the column does not need to be perfectly square, but cracks should not extend under the ferrule.

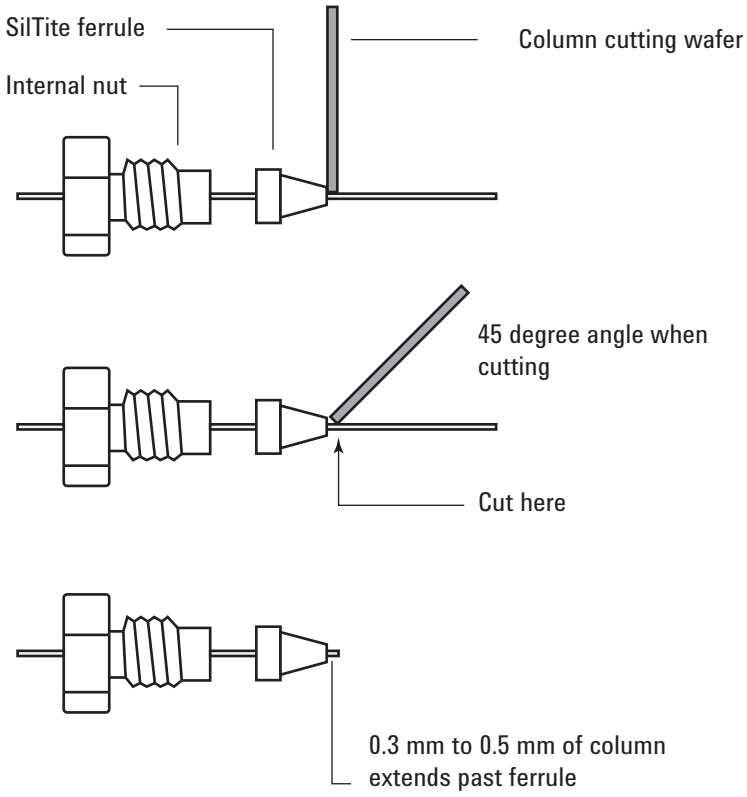


Figure 11 Technique for trimming the column in a CFT fitting

When ready to install the prepared column end, insert the assembled ferrule and nut into the CFT fitting. Tighten with a wrench by 15 to 20 degrees of rotation.

CAUTION Do not overtighten the internal nut into the fitting! If properly swaged, the fitting needs only to be tightened by 15 to 20 degrees of rotation. A properly swaged and tightened CFT connection will remain leak free for many connections.

To Disconnect Fused Silica Tubing From a CFT Fitting

Loosen and remove the internal nut. If the column and ferrule do not come free, insert a pointed object (pen, paper clip) into the ferrule release hole (see Figure 12) and press firmly. You will hear a click as the ferrule releases.

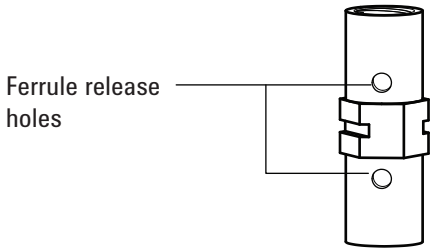


Figure 12 CFT union ferrule release holes

To Select In and Out Column Segments

The short column used to connect the GC inlet to the LTM column is called the *In segment* (for consistency with 7890A GC column configuration). This column can also be referred to as a guard column, transfer line, or retention gap (depending on its uses). Similarly, the piece of column used to connect the GC detector (or other hardware) to the LTM column exit will be called the *Out segment*.

When selecting column material for use as the In segment or Out segment, consider the following:

- In general, use uncoated deactivated fused silica of the same id as the analytical column. Using the same id column can help avoid peak broadening and other issues.
- Cut a piece of fused silica that is long enough to let you open the LTM oven door at least half-way, plus some length to allow for several trimmings.
- Typically use a length of column 40 to 50 cm long.
- If possible, avoid very long lengths. While the GC oven typically remains isothermal, it is still best to avoid a segment that touches the GC oven walls when possible.
- In some cases, using shorter In and Out column segments provides better results. By using shorter segments, from 25 cm to 27 cm long, you can minimize the chance of cold spots caused by these columns touching the GC oven walls.

Always measure the actual segment lengths used. Enter these measurements when configuring the LTM column in the GC.

To Install an LTM Column Module onto a Transfer Line Module

Figure 13 shows the column module and transfer line module.

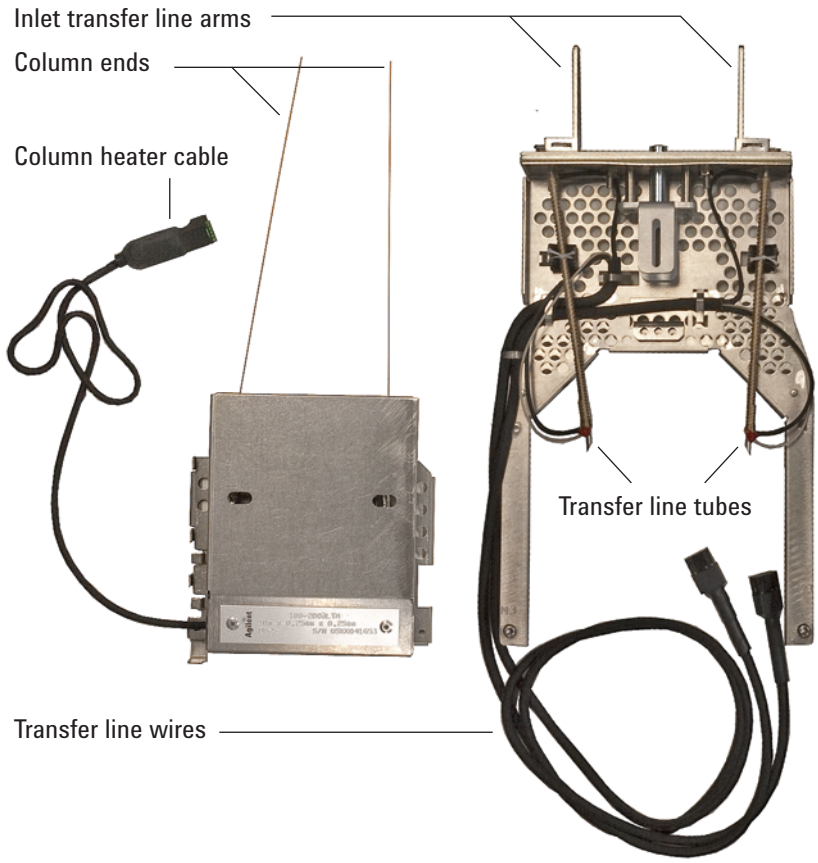


Figure 13 Column and transfer line module parts (3-inch module shown)

1 Gather the following:
   - Column module
   - Transfer line module sized for the column module
   - Posidrive screwdriver
   - T-10 Torx driver
   - Scissors

2 If attached, remove the two screws from the ends of transfer line module. These M3 x 6 mm long screws will be used to attach the two corners of the column module to the ends of the transfer line module.

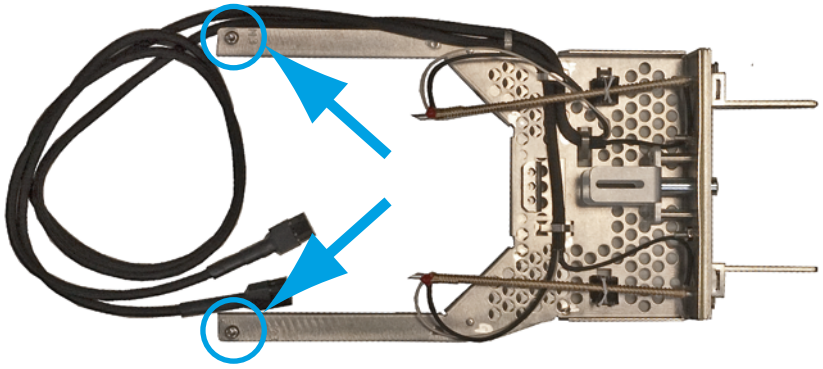
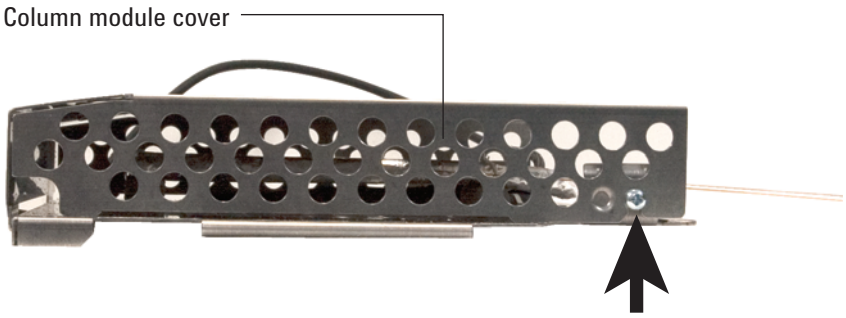


Figure 14 Removing the mounting screws (3-inch transfer line module shown)

WARNING **Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

CAUTION The column module cover mounting screws are very short. Loosen only enough so that the column cover can be removed. Hold the column module over a table or other surface that can catch a screw that is accidentally removed.

3 Loosen the two screws that secure the column module cover, then tilt to remove the cover.



4 Cut the tie wraps that secure the transfer lines in place.

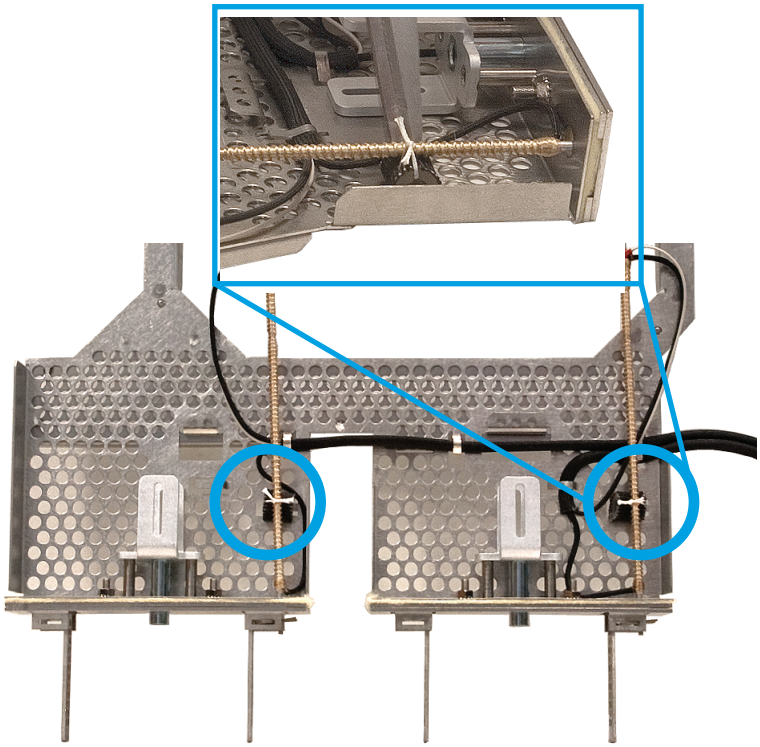
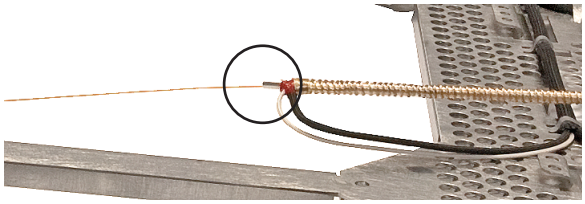


Figure 15 Cut the tie wraps that secure the transfer lines (5-inch transfer line module shown)

5 Hold the column module over the transfer line module so the column ends align with the transfer line tubes. Slide the ends of each column into the transfer lines.



6 Gently slide the column module forward, letting the column ends go through the transfer lines, until the column module frame nears the transfer line module. Align the brackets in the bottom of the column module with the rails on the transfer line module.

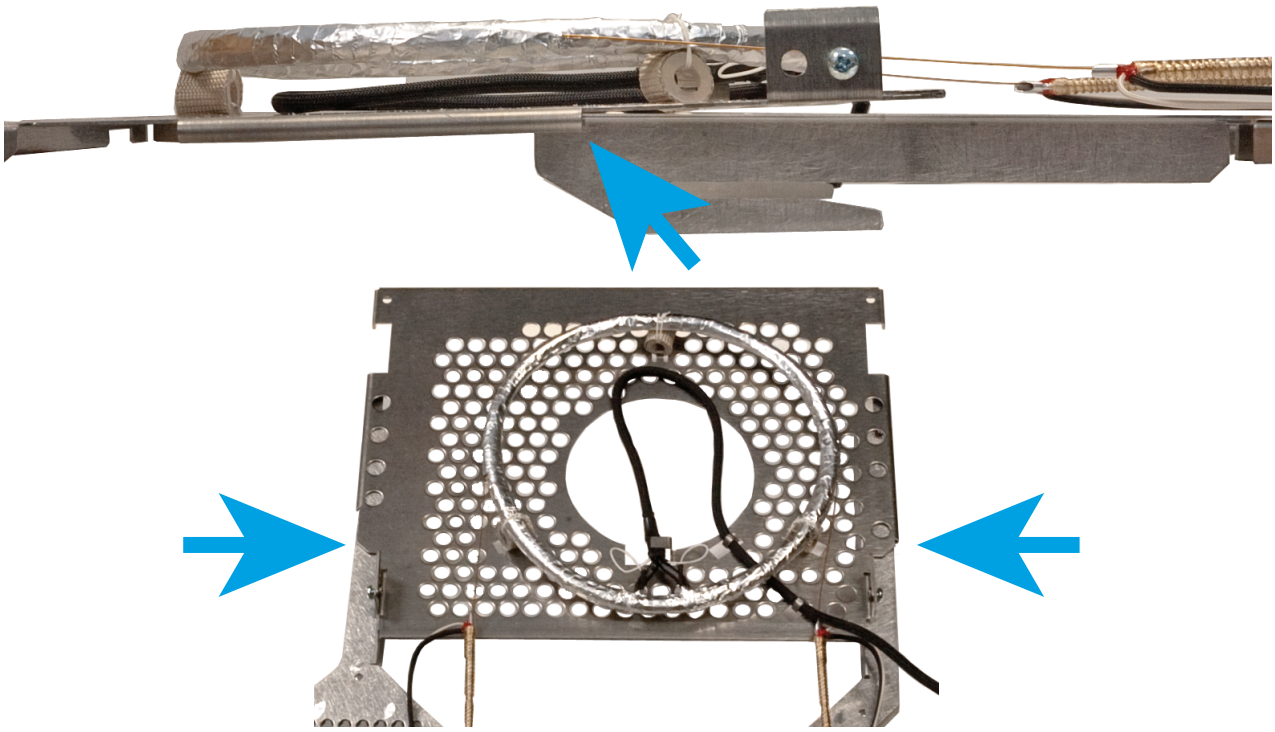


Figure 16 Aligning the column module bracket onto the transfer line module rails

7 Continue to carefully slide the column module forward. As the foil-wrapped column approaches the transfer lines, use a finger to gently move the column as needed to make sure the column sits evenly between the transfer lines.

- The transfer lines must not cut the foil wrap.
- Keep the column centered between the transfer lines so that the least amount of column is exposed on either side. In most cases, no column is exposed.
- The column module should slide under the retaining clips in the transfer line module.

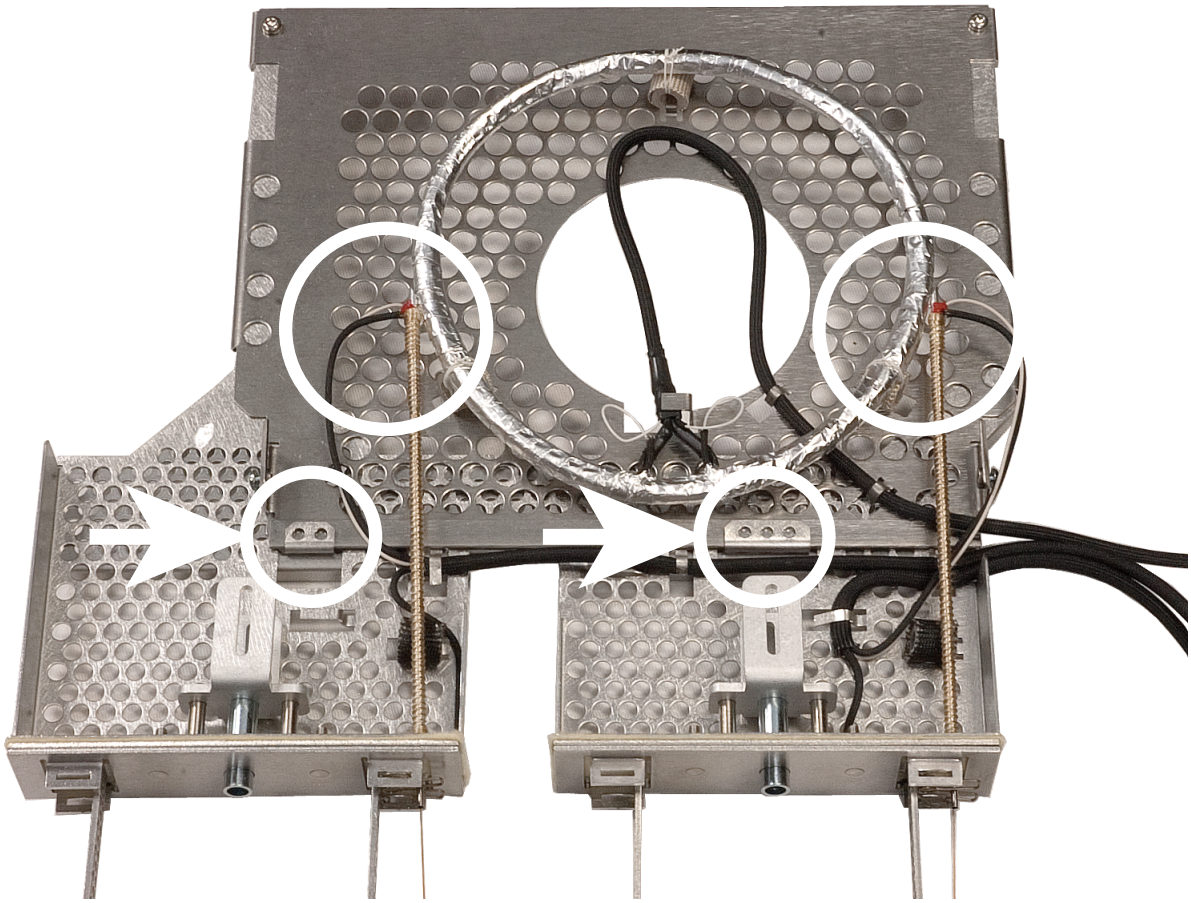


Figure 17 Column module in place on transfer line module (5-inch column module shown)

WARNING **If the column module does not easily slide onto the transfer line module rails, check for interference from wiring. Damage to the wires can result in electrical shock and equipment failure.**

CAUTION To avoid breaking the column, the transfer lines should very closely approach, but not press into, the column assembly.

8 Check for correct installation:

- The wrapped column should just meet the end of each transfer line. (See Figure 18.)
- The transfer line should cover the exposed column.

- The free column leads should extend past the two posts where the column leads exit the module assembly. See Figure 19.

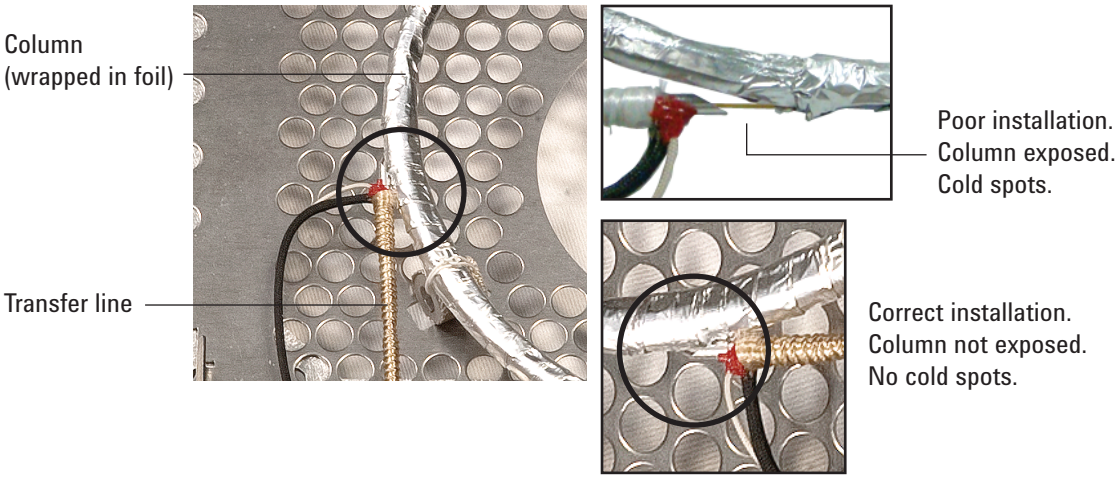


Figure 18 Correct installation of column into transfer line

9 Secure the column module to the transfer line module using the two screws (removed in step 2).

10 Route the transfer line wires inside the screw mounts for the column module cover. See Figure 19.

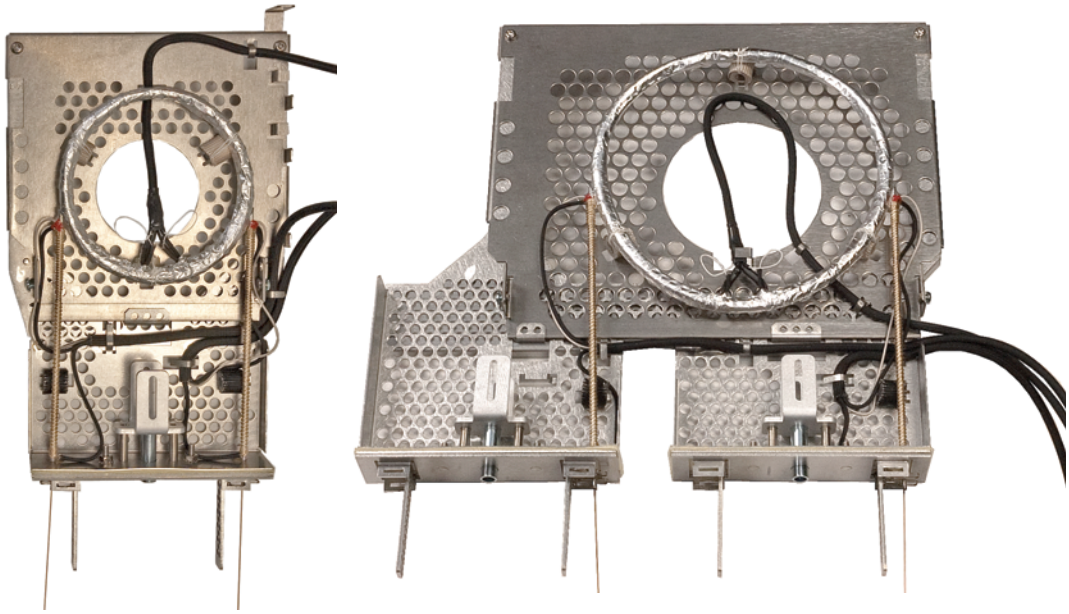
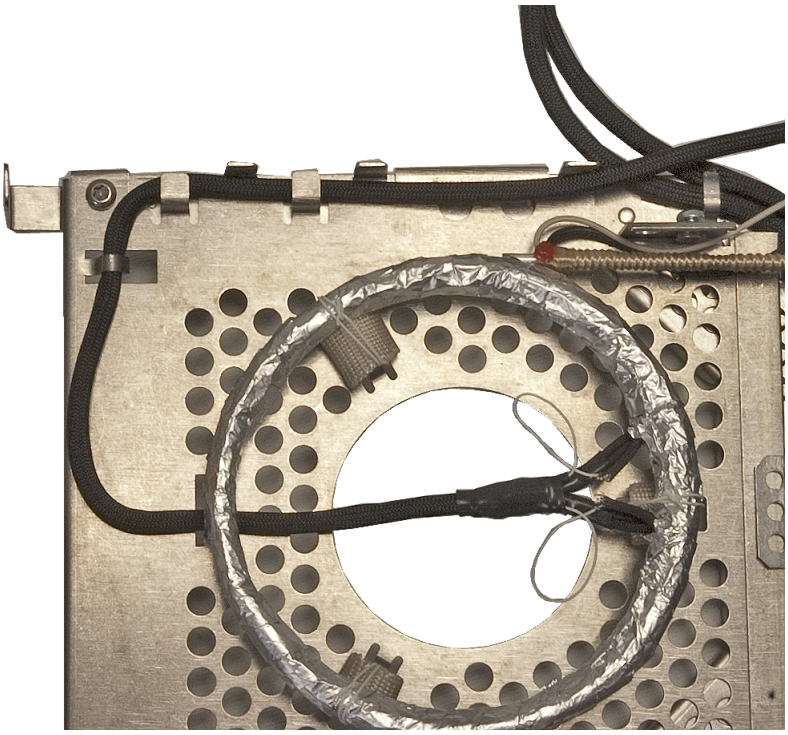


Figure 19 Routing the transfer line heater wires

11 If using a 3-inch column module, route the column heater wires through the retaining clips on the side of the column module chassis. See Figure 18.



12 Install the column module cover. Tighten the two screws to secure.

- Be careful. Do not cut any wires when lowering the cover

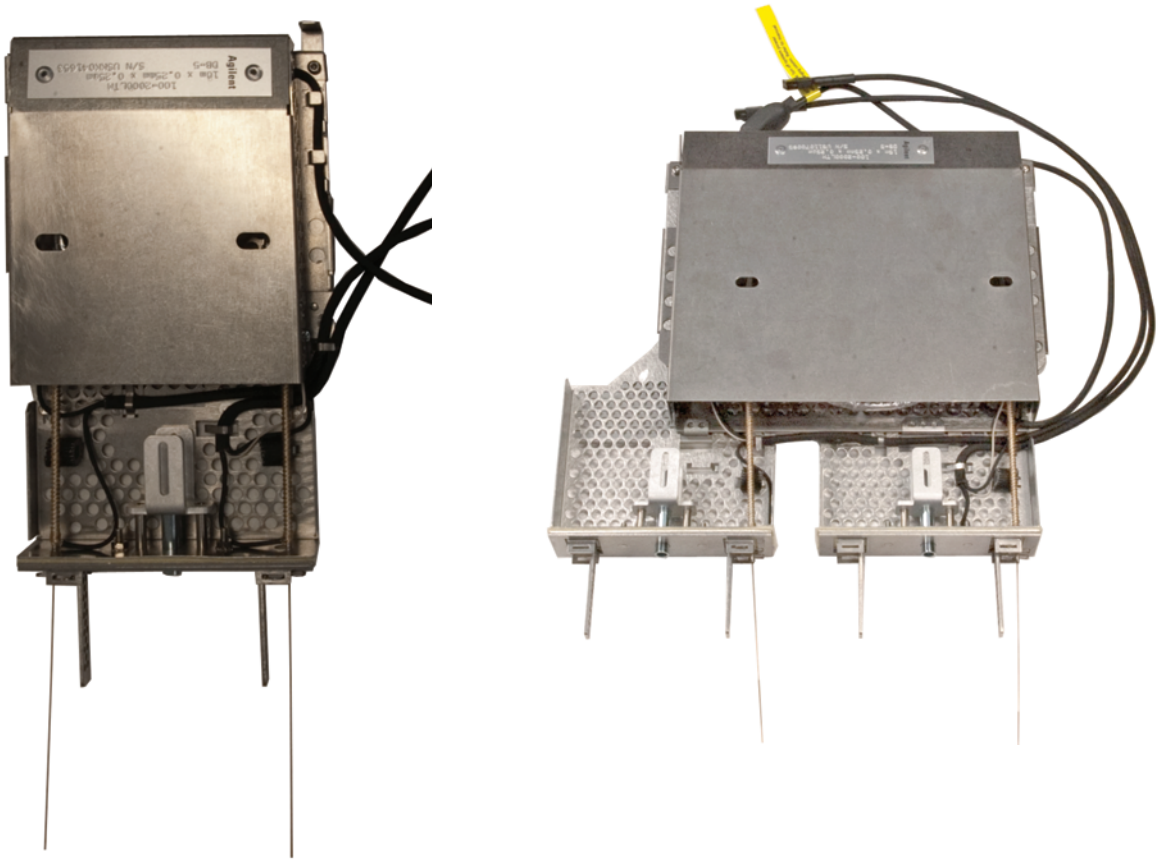


Figure 20 Column modules installed onto transfer line modules

Column module assembly to the transfer line module is complete.

Tips:

- Always handle the column and transfer line module assemblies as if separate items.
- Periodically check the screws that secure the column module to the transfer line module.

CAUTION Do not trim the column ends before understanding how the sliding union attachment works. The correct position of the union increases the number of times the column may be trimmed in its lifetime.

To Connect the Column to the CFT Unions

Prepare the column ends and install them into the CFT unions as described below. Agilent recommends using the CFT unions. When properly installed, the CFT unions provide reusable leak-free connections.

You can connect the unions to the column ends before or after installing the LTM column module into the LTM oven door. Often it is more convenient to make these connections on a lab bench.

NOTE Agilent strongly recommends reading this entire section before attempting to install the union. If not familiar with Agilent's CFT fittings and unions, first practice CFT ferrule installation on a scrap non-LTM column or column segment.

1 Gather the following:

- Column cutter, wafer (5181-8836, 4/pk)
- Magnifying loupe, 20X (430-1020)
- Gloves, heat-resistant (for handling hot parts)
- Gloves, lint free (to prevent contamination of the column, ferrules, and so forth with skin oil and dirt)
- SilTite ferrule, appropriate for the column size (see "Consumables and Replacement Parts")
- Two 1/4-inch open-end wrenches. Alternate: Substitute one 6-mm wrench for a 1/4-inch wrench.
- T20 Torx driver
- Short metric ruler
- One 7/16-inch open end wrench

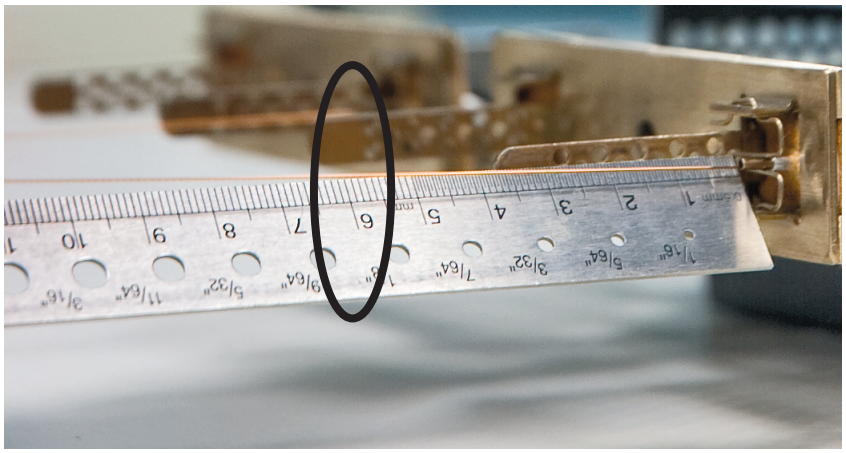
CAUTION Wear clean, lint-free gloves to prevent contamination of the parts.

2 If not already done, install the column module onto the transfer line module. See "To Install an LTM Column Module onto a Transfer Line Module".

3 Trim the column.

For a new installation, cut the column to approximately 60 mm from the face of the transfer line assembly.

If reinstalling a column module, inspect the column end with a magnifier. If cracked or damaged, trim a very small length, a few millimeters, from the end.



4 Clean the column end with an alcohol wipe.

5 Slide one internal nut over the inlet column end.

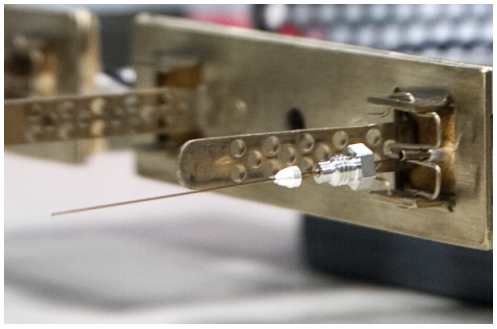
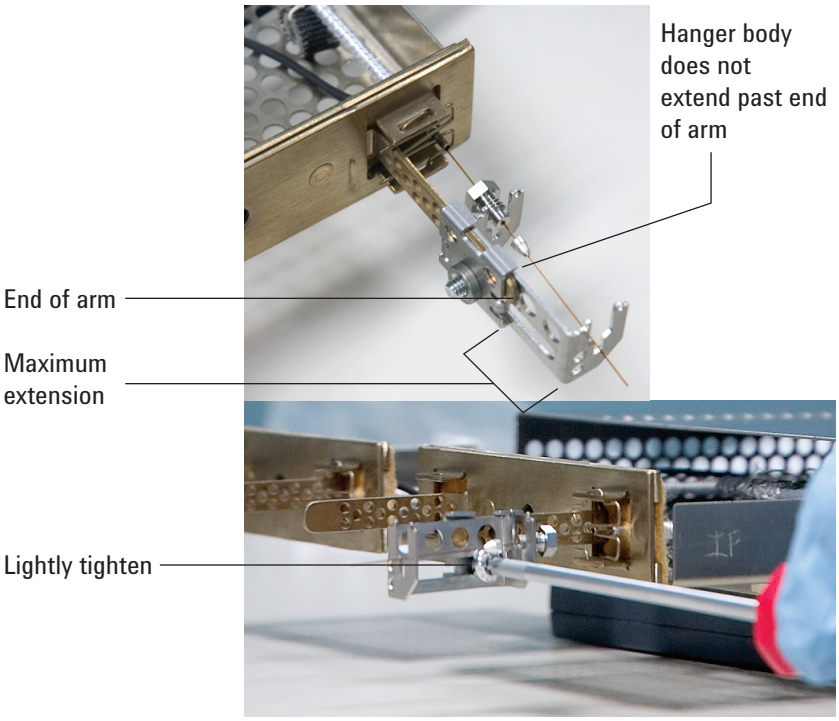


Figure 21 Internal nut and SilTite ferrule on column

6 Slide the appropriate SilTite ferrule over the inlet column end. See Figure 21.

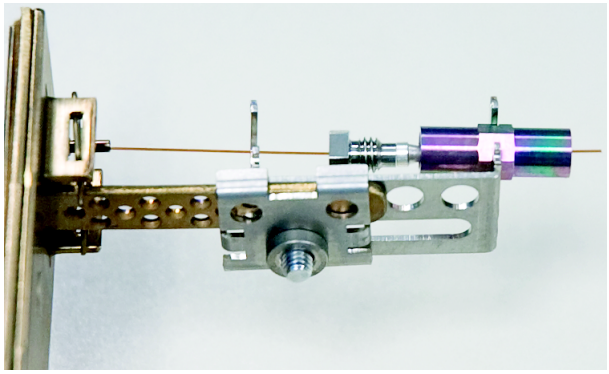
7 If not already installed, slide one union hanger assembly onto the inlet transfer line arm as shown. Be sure the hanger is at maximum extension on the arm. Use a T20 Torx driver to tighten the screw until the hanger does not slide freely. Do not tighten completely.

8 If a union hanger is already installed, slightly loosen the mounting screw so that the hanger can slide when needed.



9 Slide the column end through a CFT union and place the CFT union into the hanger as shown.

- For new installations, again check that the hanger is at maximum extension without extending past the end of the arm as shown below.



- For existing installations, slide the hanger to reach the open column end.

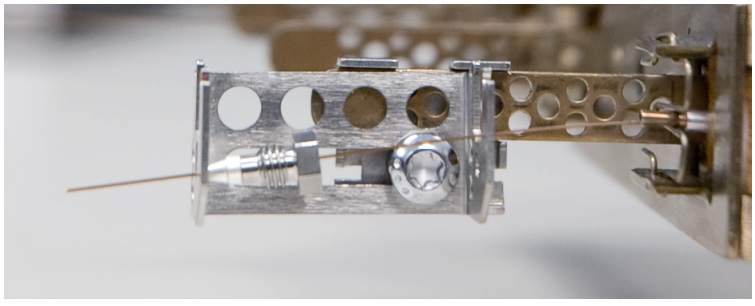
10 Using two 1/4-inch open end wrenches as shown in the photo, swage the SilTite ferrule onto the column by turning the internal nut until it grips the column. Then turn 45 to 60 degrees (one flat) further. **Do not rotate more than 60 degrees.**

- Alternately, use a 1/4-inch wrench on the CFT union and a 6-mm wrench for the internal nut.

11 After tightening, lift the union from the bracket. Gently pull the column to determine if the swage is secure. If not secure, tighten by no more than 10 ° rotation.

NOTE If the system fails to hold pressure on the initial leak test after installing a column module, check this connection first.

12 Using two wrenches, loosen the internal nut completely and remove the CFT union from the hanger.



13 Use a wafer column cutter to trim the column at the small end of the ferrule. See Figure 22.

a Place the wafer on the column, then slide along the column until it rests against the end of the ferrule.

b Tilt the wafer at an approximate 45 degree angle.

c Score the column and remove the loose end.

This technique will leave approximately 0.3 mm of column extending beyond the ferrule.

- Do not use other column cutting tools. The ceramic wafer helps provide the correct trim length.
- The column cannot extend more than 0.5 mm from the end of the ferrule.
- Check the end of the column with a magnifier. The end of the column does not need to be perfectly square, but cracks should not extend under the ferrule.

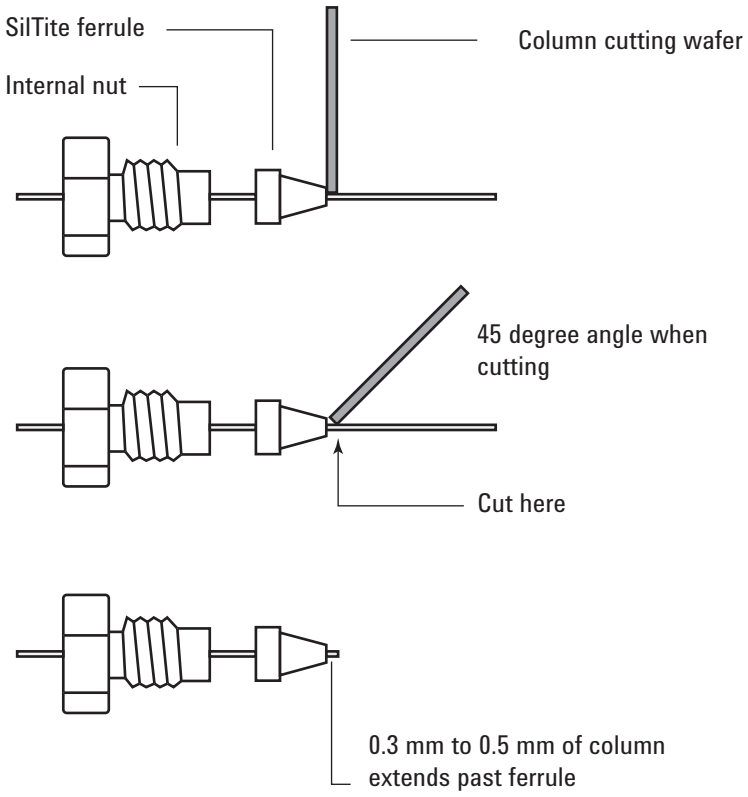
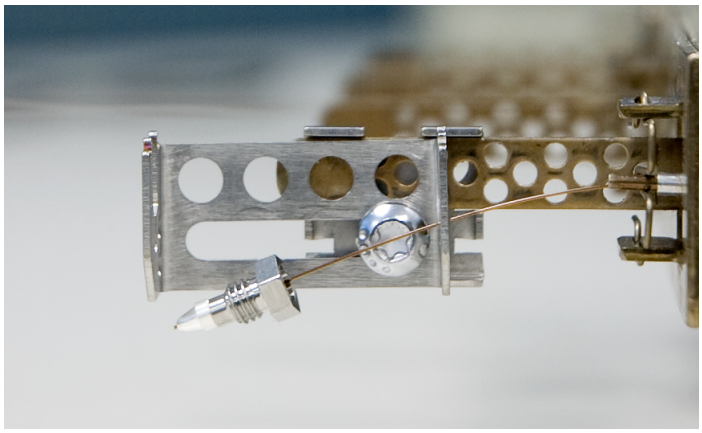


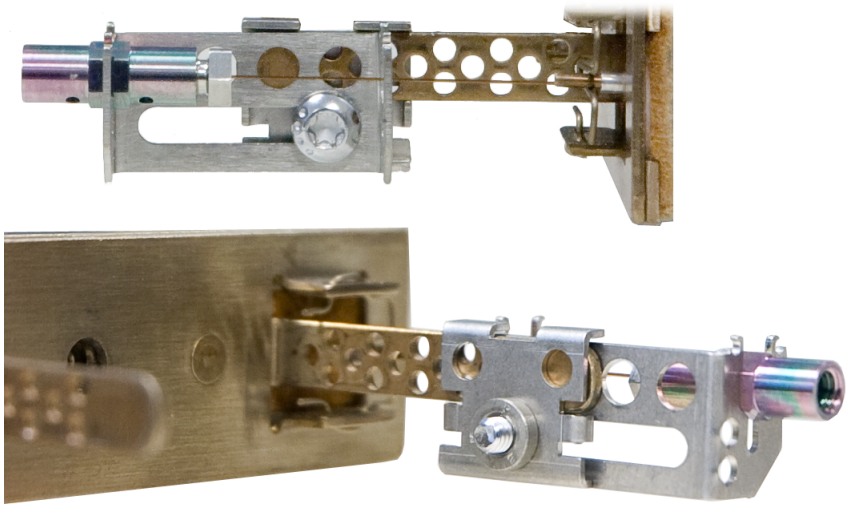
Figure 22 Proper technique for trimming the column in a CFT fitting

CAUTION Do not overtighten the internal nut into the fitting! If properly swaged, the fitting needs only to be tightened by 15 to 20 degrees of rotation. A properly swaged and tightened CFT connection will remain leak free for many connections.



14 Place the CFT union back into the hanger and insert the column end. Tighten finger-tight, then use two wrenches to tighten an additional 10 to 15 ° (about one-half of a flat).

15 Use a Torx T20 driver to carefully tighten the hanger to the arm. See the photos below for the final positioning.



16 Follow the same procedure to install the union on the other column end.

To Install a Column Module Assembly in the LTM Oven Door

This procedure assumes that you are installing the column module into an empty location in the LTM oven door. If installing a column module in a new location, first prepare the LTM oven door and install the fan. See "Install the fan module". To remove an existing column module, see "To Remove a Column Module Assembly from the LTM Oven Door".

Also, a module assembly can be installed into the LTM oven door before or after attaching the CFT unions to the columns. This procedure assumes the CFT unions are installed.

WARNING **Be careful! The oven or internal oven accessories may be hot enough to cause burns. If either is hot, wear heat-resistant gloves to protect your hands or allow the parts to cool before beginning the work.**

1 Gather the following:
   - Module assembly to install
   - Gloves, heat-resistant (for handling hot parts)
   - Gloves, lint free (to prevent contamination of the column, ferrules, and so forth with skin oil and dirt)

2 Set the GC oven, inlets, and detector temperatures to 35 °C and allow them to cool.

3 When the GC components are cool, turn off the GC.

4 If installed, remove the LTM top cover. See "To Remove the LTM Top Cover".

5 Place a felt insulation gasket over the two rails and union connections on the transfer line module. Tuck the gaskets under the retaining springs for the transfer lines so that each sits evenly over the end face of the transfer line module. See Figure 23.
   - Do not touch the insulation to open column or union ends.
   - The tight clearance of the gasket over the retaining springs should hold it in place.
   - The small module (3-inch) requires one gasket. The standard module (5-inch) requires two gaskets (one for each slot).

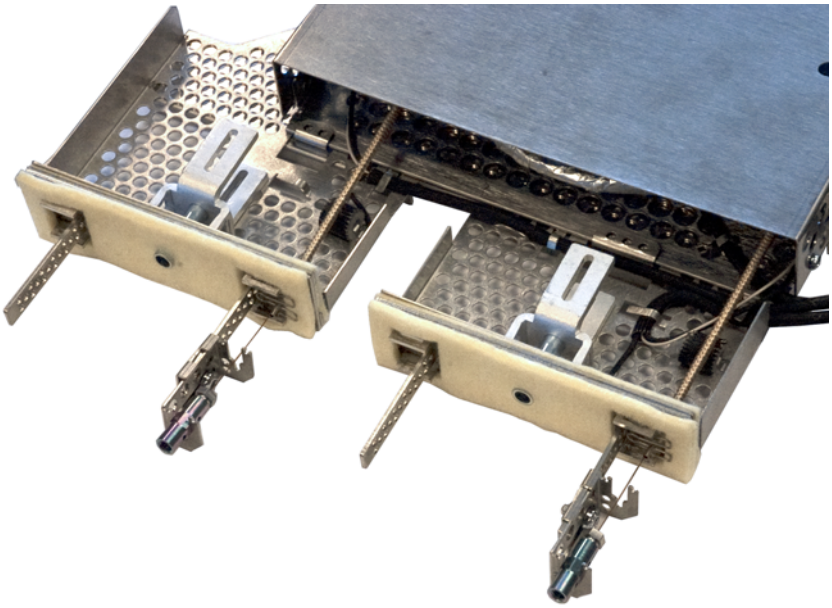


Figure 23 Gaskets installed on a 5-inch module assembly

6 Hold the LTM column module over the fan, then slide forward. Align the clips beneath the column module with the tabs on the fan assembly. See Figure 24. As the column module slides towards the LTM oven door, carefully align the unions, brackets, and posts with the through holes in the LTM oven door. The tolerances are close. Slightly adjust (spread) the posts if needed.

   - If you have an assembly that is not clampless, lift up slightly on the module assembly until the thumbscrew heads of the clamps are cleared, and then the assembly will drop down into place and slide forward into the oven and the tabs will lock into the slots in the transfer line module.

Figure 24 Align the module assembly clips over the tabs on the fan bracket

CAUTION When securing the module from inside the oven do not over tighten. Finger tight is too tight!

7 Secure the module with the captive screw(s) from the inside of the LTM oven door. Tighten enough to establish a reasonable seat against the highly compressible ceramic paper gasket.

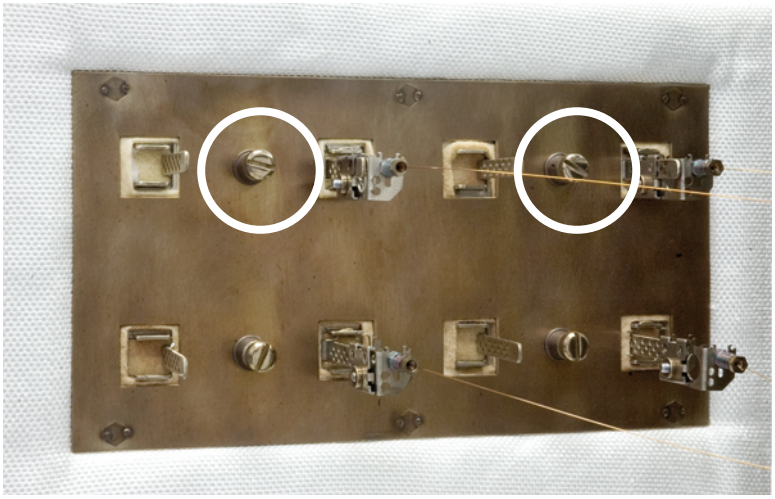
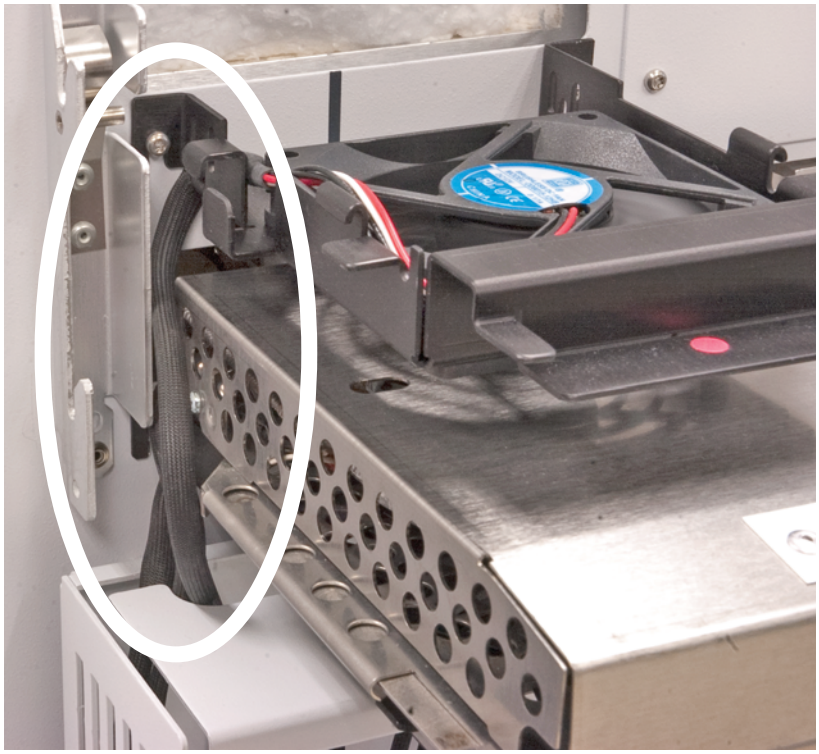


Figure 25 Two column modules installed in LTM oven door (shown after installation of unions)

8 Unplug the power supply (or supplies) from mains voltage.

9 Open the electronics enclosure by gently turning the small knob counterclockwise as described in "Connect the power supply and communications cables".

10 Route the transfer line and column module connections (total of three cables and connections per module) down and through the large slot on the top left of the electronics housing.



CAUTION All electrical cable connectors for any one module (column and transfer line) must connect to the same section on a single electronics board. See Figure 26 and Figure 27.

11 Connect the column cable and transfer line cables to the electronics board.

- The connectors are keyed and will only go onto the board one way.

- If removing transfer line connectors from the board, remove them by gripping the connector and not by pulling on the cable. The cable wires are easily damaged.
- The transfer line cables can go to either transfer line connector on the electronics board (as long as it is for the correct module).
- Check your work. Make sure each connector installed over all pins, not just one row.

See Figure 26, Figure 27, Figure 28, and Table 3.

Table 3 Electronics board connectors

	Module 1	Module 2
Column module	P2	P6
Transfer lines	P3 or P4	P7 or P8
Fan cable	P5	P9
	Other connections	
Power cord	J1	
Communications cable	P1	

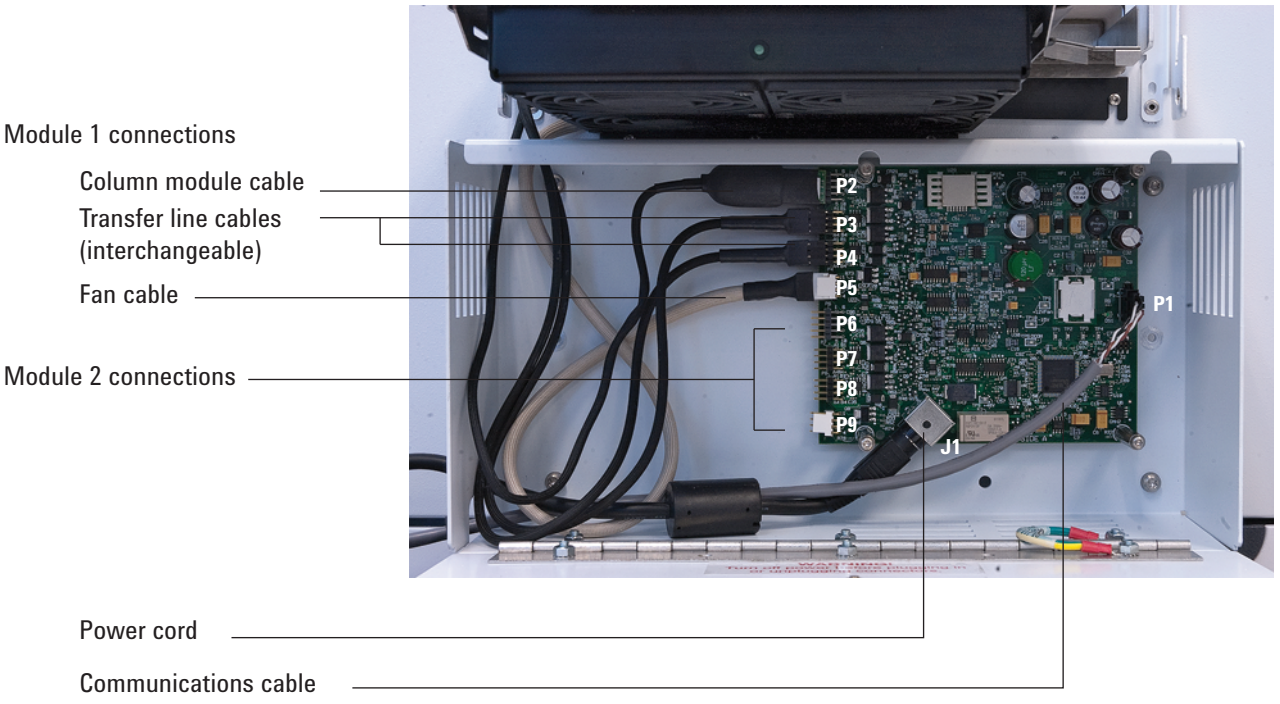


Figure 26 LTM electronics board cable connections

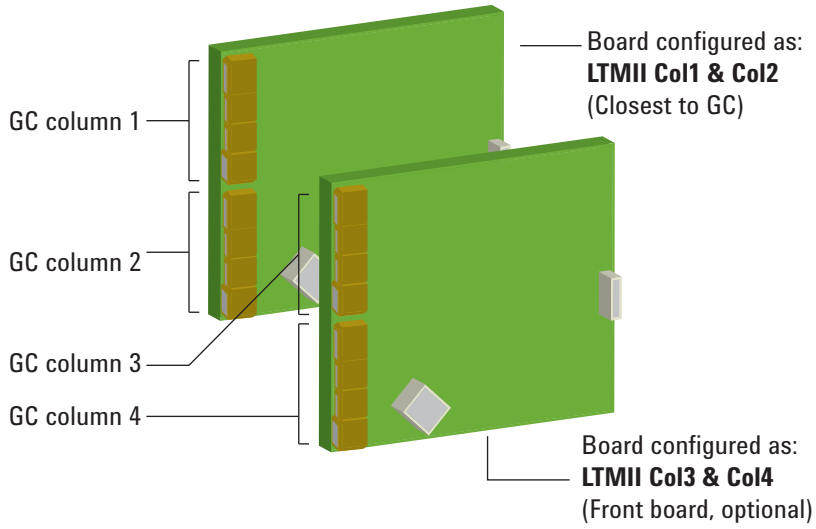


Figure 27 7890A GC column assignments by electronics board position

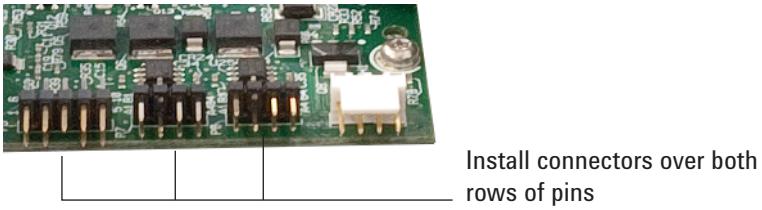


Figure 28 Close-up of column module heater and transfer line connections on electronics board

12 Close and secure the cover on the LTM electronics housing.

13 Reinstall the LTM top cover and secure with its two screws.

Column module installation is complete.

Normally, leave the GC powered off until after installing the In and Out segments. Leaving the GC powered off prevents accidental shutdown conditions and heating of some components while working.

To Install an In or Out Segment to the Column Module Union

After installing the LTM column module to the LTM oven door, next install the In segment and Out segment to connect the LTM column to the GC inlet, flow splitter, or detector.

See also "To Attach a CFT Nut and Ferrule to a Capillary Column".

1 Determine the size of uncoated fused silica to use for the in and out segments. See "To Select In and Out Column Segments".

2 Gather the following:

- Appropriate diameter uncoated fused silica
- SilTite ferrules sized for the column diameter
- 2 Internal nuts, one for each LTM column connection
- Appropriate ferrules and fittings for the other connection (to the GC inlet, detector, splitter, or other device)

3 Measure a section of fused silica column a few centimeters longer than needed (to allow for trimming).

- Consider the length needed carefully. Use some extra length to allow for future trimming and reuse, but avoid extra lengths that may allow the column to get caught in the LTM oven door, or to touch the GC oven walls.
- In some cases a minimum length is needed to reduce the chance of cold spots, where the columns touch the GC oven walls. The minimum final length is 25 cm to 27 cm, which will allow the GC oven door to open between 1/4 to 1/3 of its full amount.

4 Install the In segment into the GC inlet.

5 Install the Out segment into the GC detector (or other device).

6 Cut the In and Out segments to final length. If needed, verify that each length is sufficient by closing the oven door. The column segments should reach the CFT unions on the transfer line module while the door is still open enough for you to install them.

7 Measure the segment lengths.

8 Prepare the open ends of the column segments for connection to the CFT union on the transfer line module.

See “To Attach a CFT Nut and Ferrule to a Capillary Column”.

9 Connect the In and Out segments to the CFT unions at the module assembly. Close the oven door enough to make the connections.

- When tightening, use one wrench to keep the CFT union steady, and a second wrench on the internal nut.
- Tighten only 15 to 20 degrees after you feel the ferrule first contact the fitting.

10 If needed, arrange the columns on the GC column hanger as needed. Gently test closing the LTM oven door. If the door will close on the columns, rearrange them.

When finished, turn on the GC. If using a Series II column module, the GC will read primary column configuration information from the column module. Regardless of column module version, however, you will need to configure other column information. See “Configuring LTM columns”.

If the GC detects a problem during startup, turn off the GC. Check the column module and transfer line heater connections at the electronics board.

To Remove a Column Module Assembly from the LTM Oven Door

1 Gather the following:
   - Gloves, heat-resistant (for handling hot parts)
   - Gloves, lint free (to prevent contamination of the column, ferrules, and so forth with skin oil and dirt)
   - Two 1/4-inch open-end wrenches
   - One 7/16-inch open end wrench
2 Cool the GC oven and LTM columns to a safe handling temperature.
3 Remove the LTM top cover. See "To Remove the LTM Top Cover".
4 Open the LTM oven door.
5 Using two wrenches, disconnect the In and Out segments from the CFT unions.
6 Loosen the retained screws that secure the column module assembly into the LTM oven door.

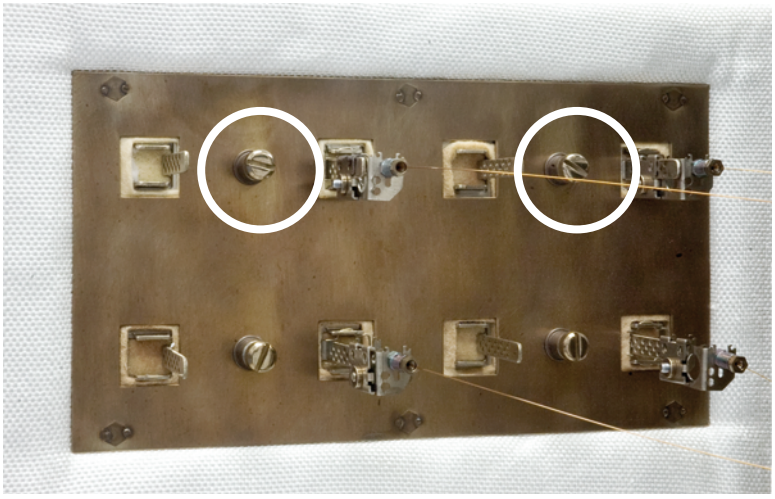


Figure 29 Two column modules installed in LTM oven door (shown after installation of unions)

7 Carefully slide the column assembly from the LTM oven door.
8 Unplug the LTM power cord.

9 Open the electronics enclosure by gently turning the small knob counterclockwise as described in "Connect the power supply and communications cables".

10 Disconnect the transfer line module and column module wires from the electronics board.

11 If installing another LTM column module, do so now. If you will not use the open slot(s), restore the GC to operation as follows:

   a Remove or reconfigure the GC columns as needed.

   b Fill the open slots in the LTM oven door with insulation. (See "Consumables and Replacement Parts".)

   c Using a T-10 Torx driver, loosen the fan bracket mounting screws and remove the fan bracket. Disconnect the fan from the electronics board.

   d Reinstall the slot cover(s).

   e Close the LTM electronics enclosure.

The CFT fittings on the In and Out segment columns can be installed into another CFT fitting as-is.

If storing the column module, protect the column ends and CFT fittings.

To Remove a Column Module Assembly from a Transfer Line Module

This procedure assumes that the module assembly has been removed from the LTM over door and is cool.

To separate an LTM column module from the transfer line assembly when using a CFT union:

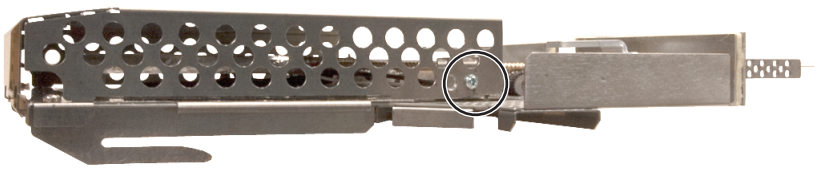
1 Gather the following:

- Column cutter, wafer (5181-8836, 4/pk)
- Magnifying loupe, 20X (430-1020)
- Gloves, heat-resistant (for handling hot parts)
- Gloves, lint free (to prevent contamination of the column, ferrules, and so forth with skin oil and dirt)
- SilTite ferrule, appropriate for the column size (see "Consumables and Replacement Parts")
- Two 1/4-inch open-end wrenches
- T20 Torx driver
- Short metric ruler
- One 7/16-inch open end wrench

2 Using two wrenches, loosen the column's internal nut at the CFT union and remove the fitting from the union. Repeat for the other column connection.

3 Slide the internal nut away from the SilTite ferrule, then use a column cutting wafer to cut the column immediately behind the ferrule. Remove the internal nut from the column and save for future use. Repeat for the other column connection.

4 Loosen the two screws that secure the column module cover, then tilt the cover and remove.



5 Remove the two screws that secure the column module to the transfer line module.

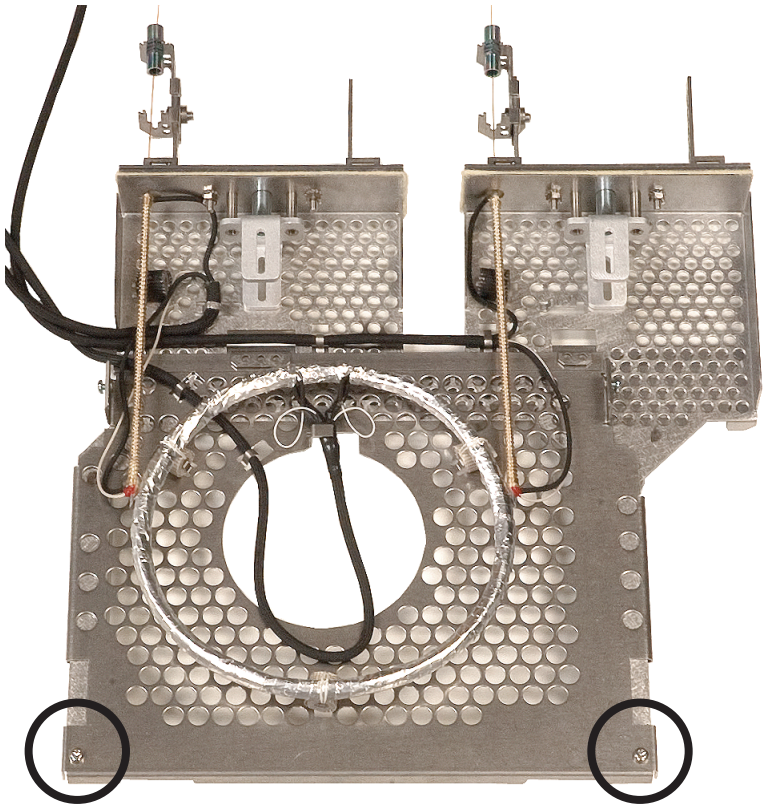
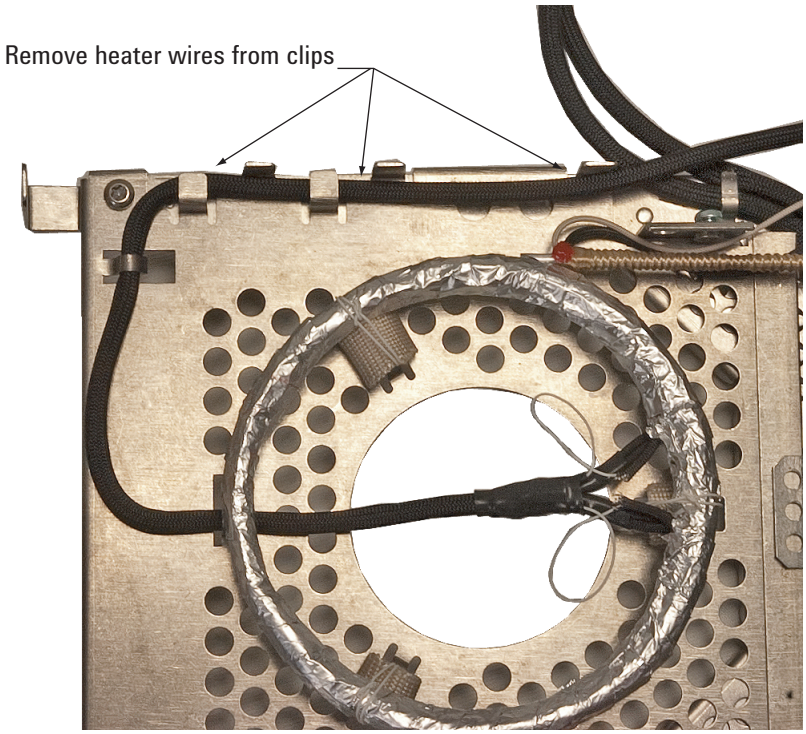


Figure 30 Removing the mounting screws (5-inch transfer line module shown)

6 For the 3-inch column module, remove the column heater wires from the clips in the transfer line module bracket.



7 Gently slide the column module off of the transfer line module.

- Be careful to avoid damaging the column ends.

8 Reinstall the column module cover. Be careful not to clip the heater wires.

9 If not re-using the transfer line module immediately, install the two column module mounting screws into the transfer line module for safe keeping.

Note that the installed unions remain on the transfer line module.

To Remove the LTM Top Cover

WARNING **Be careful! The LTM column modules and GC oven or internal oven accessories may be hot enough to cause burns. If hot, wear heat-resistant gloves to protect your hands or allow the parts to cool before beginning the work.**

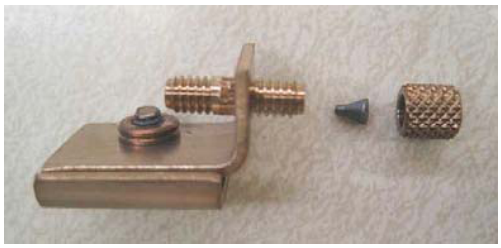
To remove the LTM top cover, remove the 2 T20 Torx screws that secure the cover in place (one on each side of the cover). Lift and remove the cover from the LTM oven door assembly.

Always reinstall the cover and screws before operating the LTM system.

To Connect the Column Using Valco ULM Unions

Use Valco Ultra Low Mass (ULM) fittings with reusable ferrules to minimize repeated trimming of the GC column. The column leads exiting the transfer line to the union are very short by design and cannot be trimmed repeatedly. The reusable ferrules allow disassembly of the module assemblies without trimming the GC column in most cases. While the reusable ferrules are not designed for use with the ULM fittings, the dead volume is adequately swept for reasonable chromatography in most circumstances. Because of the reusable design of this fitting, it is necessary to tighten the fitting after each temperature cycle in the GC oven.

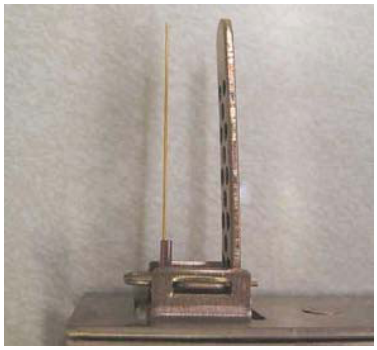
A union bracket for the LTM system using the Valco ULM union is shown below. The union is not removable from the bracket.



Start by observing the clamps with the mini-unions. The screw on each of these can be loosened just enough that the brackets can slide along the rails projecting from the oven-side of the transfer line module. It is not necessary to remove the screw; just loosening the screw will allow the bracket to slide on and off of the rail.

With the screw toward the underside of the rail, note that there are two choices for how the pair of brackets can be used: the unions can be away from the module; or the two brackets can be exchanged on the rails, and the unions can instead be positioned between the bracket and the module body.

The first position, with the unions pointed away, increases the distance between the unions and the module and is recommended for the initial installation because this minimizes the amount of column that must be trimmed. This leaves enough length of column past the ends of the transfer lines to permit the column to be cut back several times if you want to change columns and the ferrules cannot be separated from the column.



CAUTION Before trimming the column for the first time make sure the unions are pointed away from the column module as noted in the paragraph above. The union must also be slid to the position furthest away from the module. This union position will result in the maximum length of column available for future column trims.

1 Slide the knurled nut and ferrule over the capillary column.

WARNING **Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

1 Trim the capillary column to a length approximately equal to, but not past the end of the support post as shown.

2 Slide the union bracket onto the post so that the column stops in the end of the union. Unions with a small inner bore do not allow 0.4 mm and 0.5 mm outer diameter tubing to pass through the union. These columns must stop in the end of the union. At this position, the bracket should be firmly clamped onto the post using a 6.4 mm (1/4-inch) open end wrench.

3 Slide the ferrule and knurled nut up to the ULM union and tighten the nut using your fingers until the nut is snug (note that this is LESS than finger tight). Because the seal at the ferrule occurs near the tip of the ferrule, over tightening will crush the tip of the ferrule and the capillary column. It is recommended that the knurled nut be tightened until it feels snug, and then tightened an additional 10 degrees.

To undo this connection, simply remove the knurled nut and gently pull back on the ferrule. Because the rear part of the re-usable ferrule poorly fits the ULM union, it is easy to pull back with a small pair of tweezers to dislodge the ferrule if it appears to be stuck in the union. If the ferrule has not been overly tightened, it should slide off of the column leaving minimal debris on the column. Typically, these ferrules can be re-used many times.

Alternately, for the In and Out column segments, undo the connection by loosening the nut and simply pulling the column out. Leave the ferrule in place. To reconnect, insert the column, then tighten the nut. If changing In or Out column segment diameters, remove the nut from the old segment and leave the ferrule in place on the column (for future re-use). Install the new segment using a new ferrule as described above.

4
Operation

This section describes where to configure and program an LTM column module.

Operating the LTM System

The LTM system integrates fully into the 7890A GC. To program and operate the LTM system, use the GC keypad to configure the column modules and to edit the GC methods. If using a data system, the data system method editor will include all of the necessary setpoints.

LTM Series II column module configuration

The Agilent LTM Series II column modules provide the primary column configuration information (column length, id, film thickness, maximum temperature, and absolute maximum temperature) to the 7890A GC. The GC automatically reads this information and partially configures the column. The column number used depends entirely on electronics board configuration and the connectors used on the board. See “To Install a Column Module Assembly in the LTM Oven Door”.

Other GC column configuration information, such as In segment and Out segment dimensions

Configuring LTM columns

Configure each LTM column module in the GC as a composite column.

The 7890A GC can define all parts of the LTM column module columns as one “composite” column. In Figure 31, the In segment, analytical column, and Out segment are all part of a single defined GC column. By defining each segment of an LTM column, the 7890A GC can accurately control column flow even though the flow may pass through different id column material with differing film thicknesses.

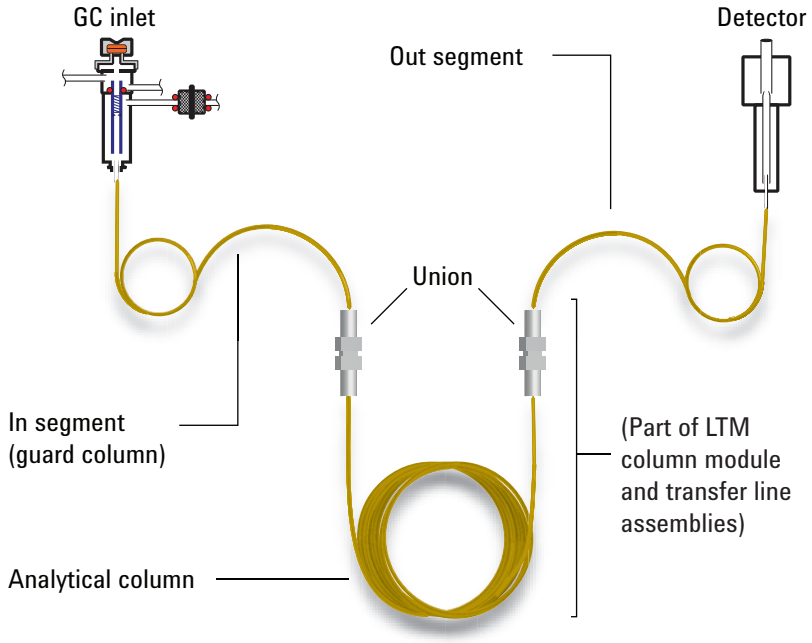


Figure 31 7890A GC Composite column parts

- For LTM Series II column modules, the GC will read primary LTM column dimensions (length, diameter, film thickness, module/column toroid size) and temperature limits from the LTM column module.
- Define the column that connects the GC inlet to the LTM column module as the **In Segment**.
- If using a Series I column module, define the LTM column as the primary column.
- Define the column that connects the detector to the column module as the **Out Segment**.
- If the column segment connected to the detector passes through a second heated zone, for example an MS transfer line, define the portion passing through the second zone as **Segment 2**.
- If using a Series I column module, set the **Module size** (**3 inch** or **5 inch**) for the whole column.

For details on configuring columns on the 7890A GC, see the 7890A GC *Advanced User Guide* (or the online help available from the data system's method editor).

LTM Series II columns and Agilent data systems

After installing a new column module, configure the new column module in the data system methods.

- Always check the data system method's column configuration and update as needed.
- If using a Series II column module that provides its own configuration information, the data system will be able to edit the column information to a more limited extent. The primary column, contained within the column module, cannot be edited for film thickness, maximum temperatures, and certain other data. You can "calibrate" the column by slightly changing its length or id (but do not do so unless you can accurately calculate these dimensions).

Programming the LTM column modules

The LTM columns typically appear in the GC display as columns 1 through 4. To program the run time column temperature and flow (or pressure) using the GC keypad, press [**Aux Col #**] then input the column number. The 7890A GC lists the column dimensions and provides settings for:

- Flow, pressure, and velocity
- Control mode (flow or pressure, ramped or not)
- Temperature ramps
- Post-run temperature

For details on configuring columns on the 7890A GC, see the 7890A GC *Advanced User Guide* (or the online help available from the data system's method editor).

If using an Agilent data system, the data system method editor provides additional controls, one for each configured LTM column module. Refer to the online help in the method editor.

LTM programming and total run time

The GC oven time controls the total run time. If an LTM column module is programmed for a shorter or longer run time than the GC oven, the LTM column program will be extended or truncated as needed to meet the GC oven run time.

5
Troubleshooting

This sections describes error messages, common issues, and how to resolve them.

Accessing LTM Diagnostic Information at the GC

The LTM Series II system integrates troubleshooting information into the 7890A GC. All LTM diagnostic information, such as fault messages, error messages, not ready messages, and more detailed information is available at the 7890A GC display. Agilent data systems may only display basic messages.

To view fault messages, use the GC status display. Press [**Status**] and use the scroll keys.

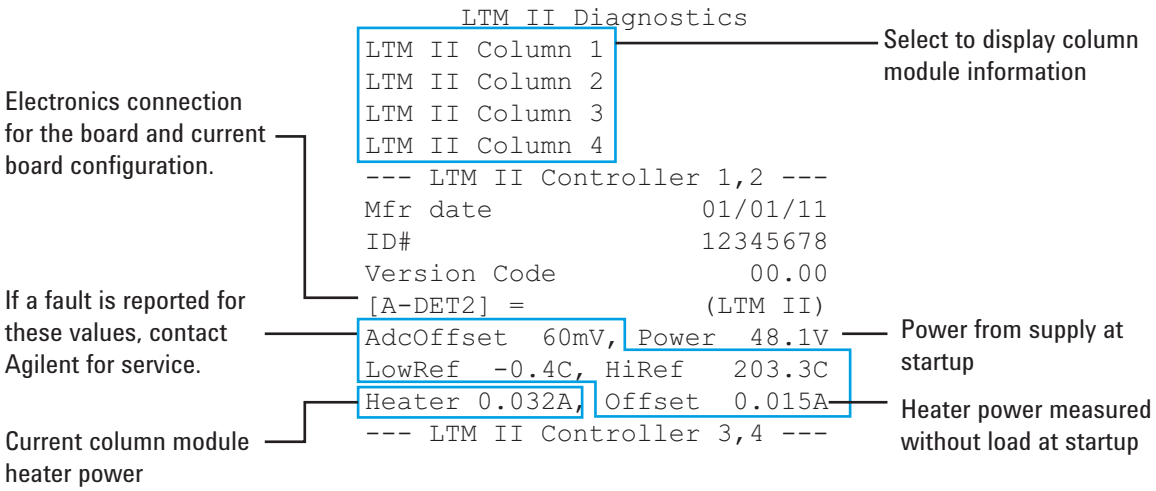
To view more details, use the GC service mode.

1 Press [**Service Mode**].

CAUTION

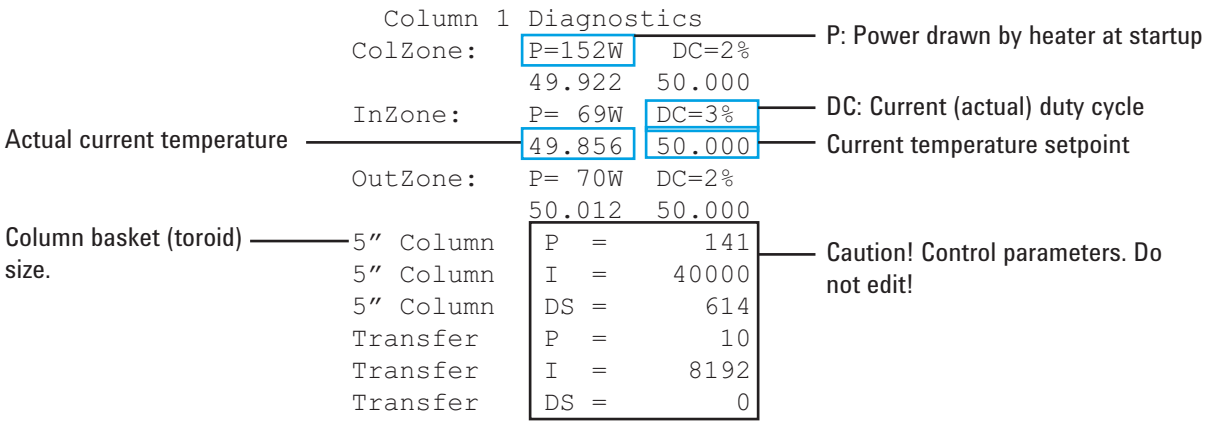
The LTM diagnostics displays include some parameters which should not be altered or changed. **Do not alter or change any settings unless specifically directed by these instructions!** Changing the PID values, for example, can prevent proper operation or damage the column module.

2 Select **Diagnostics > Ltm II Columns** to access more diagnostic information. An partial example display for an LTM system with two electronics boards and four column modules is shown below:



3 Select **LTM II Column 1**, **LTM II Column 2**, **LTM II Column 3**, or **LTM II Column 4**, and press [**Enter**] to show information specific to the selected column module.

An example column module diagnostic display may appear as shown below:



Error Messages

If the GC displays an LTM Series II system fault, check the appropriate error message below.

Also, check for more details in the GC display.

- Press [**Status**] on the GC keypad to review additional messages.
- View the configured electronics (controller) board information. See "Accessing LTM Diagnostic Information at the GC".
- View the column module information. See "Accessing LTM Diagnostic Information at the GC".

CAUTION The LTM diagnostics displays include some parameters which should not be altered or changed. **Do not alter or change any settings unless specifically directed by these instructions.** Changing the PID values, for example, can prevent proper operation or damage the column module.

After reinstalling or replacing a cable connection to an LTM electronics board, power cycle the GC. The GC checks for proper connections, power usages, and so forth only during power up.

The GC checks for out of range temperature conditions, sudden communications loss, and similar events during operation.

LTM 12 Power is Off
LTM 34 Power is Off

Indicates no power to a connected and configured LTM electronics board or column module fan. Check the following:

- Power supply. Is the LED lit? Is it plugged into the power outlet?
- Check the power cable connection to the electronics board.
- Check the fan cabling connections. Is the fan unplugged?

LTM 12 Column 1 Transfer Line 1 Heater Faulted
LTM 34 Column 4 Transfer Line 2 Heater Faulted
LTM *xx* Column *n* Transfer Line *m* Heater Faulted

Here:

- *xx* is column **12** or **34**, depending on the electronics card configuration
- *n* can be any column number, 1 through 4
- *m* is either 1 or 2, depending on the connector used by the transfer line (P3/P7 for 1, P4/P8 for 2)

With a column module connected to the electronics board, a transfer line heater appears missing. Check the following:

- Transfer line connections to the electronics board.

Reboot the GC after making any changes.

LTM 12 Column 1 Transfer Line 1 Sensor Faulted
LTM 34 Column 4 Transfer Line 2 Sensor Faulted
LTM *xx* Column *n* Transfer Line *m* Sensor Faulted

Here:

- *xx* is column **12** or **34**, depending on the electronics card configuration
- *n* can be any column number, 1 through 4
- *m* is either 1 or 2, depending on the connector used by the transfer line (P3/P7 for 1, P4/P8 for 2)

With a column module connected to the electronics board, a transfer line sensor appears missing. Check the following:

- Transfer line connections to the electronics board.

Reboot the GC after making any changes.

LTM 12 Faulted
LTM 34 Faulted

The electronics board has detected a fault. This can be caused by a device connected to the board, or a board failure. Check the diagnostic messages for further information.

Fault: 48V Shut Down

LTM electronics board detected a fault and shut down. Typically this occurs due to another fault, such as a defective heater or mis-installed cable.

Zone Exceeded Max Temp 1
Zone Exceeded Max Temp 2

The LTM electronics board detected a temperature that exceeded the absolute maximum allowable temperature by at least 20 °C. The number refers to the transfer line cable connection for the column module, 1 or 2.

Check the following:

- View the column module information. See "Accessing LTM Diagnostic Information at the GC" Check the **InZone** and **OutZone** temperatures. Check the cable connection for the one which is excessively high.
- Defective transfer line. Install a new transfer line module.

Zone not heating

The LTM electronics board detected that a heater is being supplied power without a corresponding change in temperature. Check the following:

- View the column module information. See "Accessing LTM Diagnostic Information at the GC" Check the duty cycles for the **InZone**, **OutZone**, and **ColZone**. Check the cable connection for the one which is excessively high while its temperature reading is low.
- Check the column module heater connections to the electronics board.
- Replace the column module or transfer line module reported as defective.

Other faults

If an LTM controller reports any of the following faults, contact Agilent for service:

- AdcOffset fault
- LowRef fault
- HiRef fault
- Heater offset fault

Fan LEDs

Each fan module includes one green LED to provide diagnostic information.

Table 4 Fan LED status

LED status	Column module state
Off	No power or turned off
On	Run in progress Temperature may or may not be in control
Flashing, 2 seconds per blink	Not in a run Temperature not in control
Flashing, 2 blinks per seconds	Not in a run Temperature in control

Checking for Leaks

After installing a column module, if the GC inlet cannot maintain pressure, first check the connections between the column module and the CFT unions.

Otherwise, use an electronic leak detector to check each of the union and other connections.

Perform a normal inlet leak checks and pressure decay tests as described in the GC documentation.

Perform detector leak tests as described in the GC documentation.

You can perform a pressure decay test by plugging the end of the column segment leading to the detector, or by using a CFT plug fitting (made from a piece of wire and normal SilTite ferrule) in the detector side of the CFT union. However, compared to a non-LTM system, the additional volume provided by the column segments will cause some initial, extra pressure decay until the setpoint pressure equilibrates throughout the system. After the initial decay, however, the inlet pressure should stabilize to a normal decay rate. (Because of the additional internal volume, the *amount* of decay may be larger than listed in the 7890A GC documentation but still be acceptable.)

Column Configuration Problems

The LTM Series II system normally reads the column configuration information data directly from the LTM column module. (See “LTM Series II column module configuration”.)

However, in some cases column configuration data may not appear correctly. Check the following:

- Was the electronics (controller) card configured as an LTM II controller? See “Configure the LTM electronics boards”.
- Is the column module a series I version? Older column modules do not contain configuration information and must be manually configured.
- Is the GC firmware version correct? See “Update GC firmware”

Note that while LTM Series II column modules are backwards compatible with earlier LTM systems, they do not otherwise enhance existing, older systems.

5 Troubleshooting

6
Consumable and Replacement Parts

This section lists the common consumable and replacement parts needed for routine use of an LTM GC system.

Consumables and Replacement Parts

For additional part numbers and the latest consumables, visit the Agilent website at http://www.agilent,.com/chem.

To purchase a new column module, also visit the Agilent web site.

Table 5 Consumables

Description	Part number
CFT fittings	
Internal nut	G2855-20530
CPM Union, inert	G3182-60580
LTM union holder	G6578-60120
SilTite ferrules for CFT fittings	
0.4 mm id (for 0.1–0.25 mm columns), 10/pk	5188-5361
0.5 mm id (for 0.32 mm columns), 10/pk	5188-5362
0.8 mm id (for 0.53 mm columns), 10/pk	G3185-20552
Other parts	
Column cutting wafer, 4/pk	5181-8836
Swaging nut	G2855-20555
Swaging tool	G2855-60200

Table 6 Replacement parts

Description	Part number
Screw, T10 Torx, M3 x 6 mm long, for slot cover plate	0515-0680
Gasket, LTM module assembly	G6578-00502
Slot cover plate	G6578-00501
Fan bracket assembly, for standard 12.7-cm (5-in.) column module	G6578-64025
Fan bracket, small format for 7.6-cm (3-in.) column modules	G6578-64023
Module retaining bolt	G6578-80504
Transfer line module, for one standard 12.7-cm (5-in.) column module	G6578-64015

Table 6 Replacement parts (continued)

Description	Part number
Transfer line module, for one standard 7.6-cm (3-in.) column module	G6578-64013
Upgrade kit for LTM CFT Unions (includes internal nut, swaging nut, CPM union, SilTite ferrules, and 2 LTM union holders)	G6578-60122

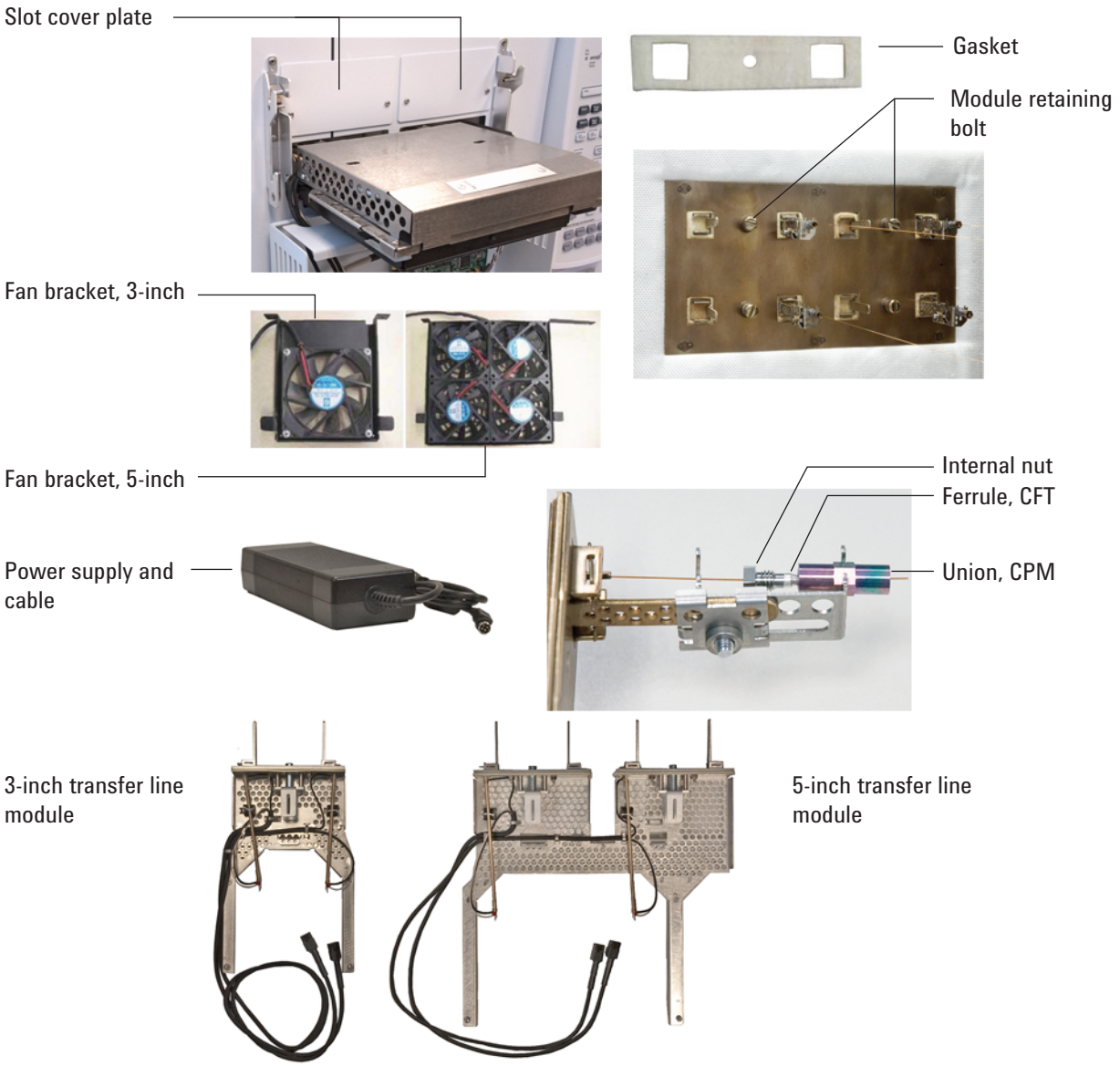


Figure 32 Selected replacement parts

7
Site Preparation

This section lists the GC and other requirements needed to install an LTM system into a GC.

Environmental Conditions

The LTM system must be operated within the recommended ranges for the gas chromatographs.

- Ambient operating temperature: 15°C to 35°C
- Storage temperature extremes: –40°C to 65°C
- Ambient operating humidity: 5% to 95% (noncondensing)
- Altitude: Up to 2000 m.

Benchtop Space Requirements

LTM oven door

The LTM oven door replaces the existing 7890A GC oven door.

- Height: 36.8 cm (14.5 in.)
- Width: 43.2 cm (17.0 in.)
- Depths: 25.4 cm (10.0 in.). With column modules installed, unit extends 18.4 cm (7.2 in.) forward from the original door.
- Average weight: 6.7 kg (14.7 lb)

The external power supply

- Height: 4.6 cm (1.8 in.)
- Width: 8.5 cm (3.3 in.)
- Depths: 21 cm (8.3 in.). Allow 5 cm (2 in.) in front and behind for power cord connections.
- Average weight: 1.1 kg (2.4 lb)

Some LTM systems use 2 power supplies.

Electrical Requirements

Line voltage requirements: 100–240 VAC, ± 10% of nominal

8 Installation

This section describes how to install an LTM system onto an Agilent 7890A Gas Chromatograph (GC).

The installation instructions assume an Agilent-trained technician performs the work.

Overview

Agilent ships a new LTM system assembly with the parts and supplies needed for installation. Some of the supplies are customized for each order. For example, if ordering a new LTM system with 2 single 320 µm columns, you will also receive 320 µm fused silica for the In and Out segments, plus sufficient ferrules needed to install 320 µm columns. If you choose to use another size of fused silica for the In and Out segments, you may need to supply appropriate ferrules.

Table 7 lists the parts supplied with the LTM system. Each system ships with the cabling required for installation to the 7890A GC.

Table 7 Low Thermal Mass System accessory parts

Description	Quantity
All LTM Systems	
Power supply	1
LTM side covers and hardware kit	1
Power cord (appropriate for country)	1
Agilent Technologies GC and GC/MS Hardware User Information & Instrument Utilities Software DVDs	1
G6678A, one standard column module, adds:	
Column module	1
Transfer line module, 5-inch	1
Fan module	1
LTM door assembly with one electronics board	1
G6679A, two standard column modules, adds:	
Column module	2
Transfer line module, 5-inch	2
Fan module	2
LTM door assembly with one electronics board	1
G6673A, one 3-inch column module, adds:	
Column module	1
Transfer line module, 3-inch	1

Table 7 Low Thermal Mass System accessory parts (continued)

Description	Quantity
Fan module	1
LTM door assembly with one electronics board	1
G6674A, two 3-inch column modules, adds:	
Column module	2
Transfer line module, 3-inch	2
Fan module	2
LTM door assembly with one electronics board	1
G6680A, two standard column module with two power supplies, adds:	
Power supply, additional	1
Column module	2
Transfer line module, 5-inch	2
Fan module	2
LTM door assembly with two electronics boards	1

Each LTM oven door assembly includes communications cables (G6578-60110), as needed, for connecting the ordered number of electronics boards to the GC. The door assembly also includes screws (0515-0680, 10 each) for installing up to the maximum number of fan modules allowed.

Each column module includes appropriate cabling for connection to an electronics board.

The shipped LTM system also includes:

- Appropriate fused silica (sized to match the column modules) for creating the In and Out segments that connect the column modules to the GC inlet and detector.
- Required consumables and supplies for completing the installation.

See "LTM System Components" for descriptions of important LTM parts.

Tools and Materials Required

To install the LTM system, you will need the following:

- T-20 Torx driver
- T-10 Torx driver
- Agilent Instrument Utilities software, version B.01.01 or greater (for 7890A GC firmware update, if needed). The latest version of this utility is provided with the LTM system.
- Column cutter, wafer (5181-8836, 4/pk)
- Magnifying loupe, 20X (430-1020)
- Gloves, heat-resistant (for handling hot parts)
- Gloves, lint free (to prevent contamination of the column, ferrules, and so forth with skin oil and dirt)
- SilTite ferrule, appropriate for the column size (see "Consumables and Replacement Parts")
- Two 1/4-inch open-end wrenches
- Short metric ruler
- One 7/16-inch open end wrench

Prepare the GC

Before installing the LTM system, prepare the GC.

WARNING **Refer to the 7890A GC Safety Manual for hazards that may exist when maintaining your instrument. This manual can be found on the Agilent GC and GC/MS Hardware User Information & Instrument Utilities software disks that ship with the LTM II product and the Agilent 7890A GC.**

Cool the GC and prepare the MS (if installed)

WARNING **Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear gloves to protect your hands.**

Cool all heated components of the GC to a safe handling temperature, including the oven, inlets, and detectors. GC components cool faster if you set their temperatures to ambient and leave the GC powered on.

If using an MS or MSD, vent the MS or MSD and disconnect the transfer line from the GC. (See the MS or MSD user documentation for details.) Move the MS to the side to allow access to the left side of the GC.

NOTE Vent even if using an Agilent QuickSwap accessory. LTM system installation requires shutting down the GC.

Update GC firmware

The LTM system requires 7890A GC firmware version A.01.12.1. Later firmware versions should be compatible. Earlier versions are not compatible. Check the GC firmware version and update it using Agilent Instrument Utilities software if needed.

- Agilent provides the Instrument Utilities software and user documentation on 2 DVDs in the LTM system ship kit.

- To check for the latest available firmware version for the GC, visit the Agilent web site at http://www.chem.agilent.com/en-US/Support/Downloads/firmware/Pages/GC.aspx.

1 Determine the GC firmware version. At the GC keypad, press [**Status**][**Clear**]. The GC displays the current firmware revision.

2 If the GC firmware version is earlier than A.01.12.1, use the Instrument Utilities software to update the GC firmware.
   - Refer to the software help for instructions.
   - If storing methods in the GC, record them before beginning. While the firmware update utility restores the active method, any stored methods are lost.

Install the GC metal left side panel

For safety reasons, replace the plastic side panel that shipped with the GC with a metal side panel included in the LTM system ship kit.

WARNING **Failure to use the metal side panel can compromise the safety features of the GC.**

1 Turn off the GC and unplug the power cord.

2 The GC left side panel is held by 2 captive screws at the bottom and a hook at the rear. Loosen the screws and slide the panel to the back to remove it.

3 Select the correct metal left side panel:
   - If not using an MSD, use G6578-00028.
   - If using an MS or MSD, use G6578-00029, which includes a through-hole for the MS transfer line.

4 Install 4 standoffs onto the GC. Install the two 23 mm long standoffs provided in the kit into the bottom threaded holes shown in Figure 33 below. Install the two 13 mm standoffs at the top.

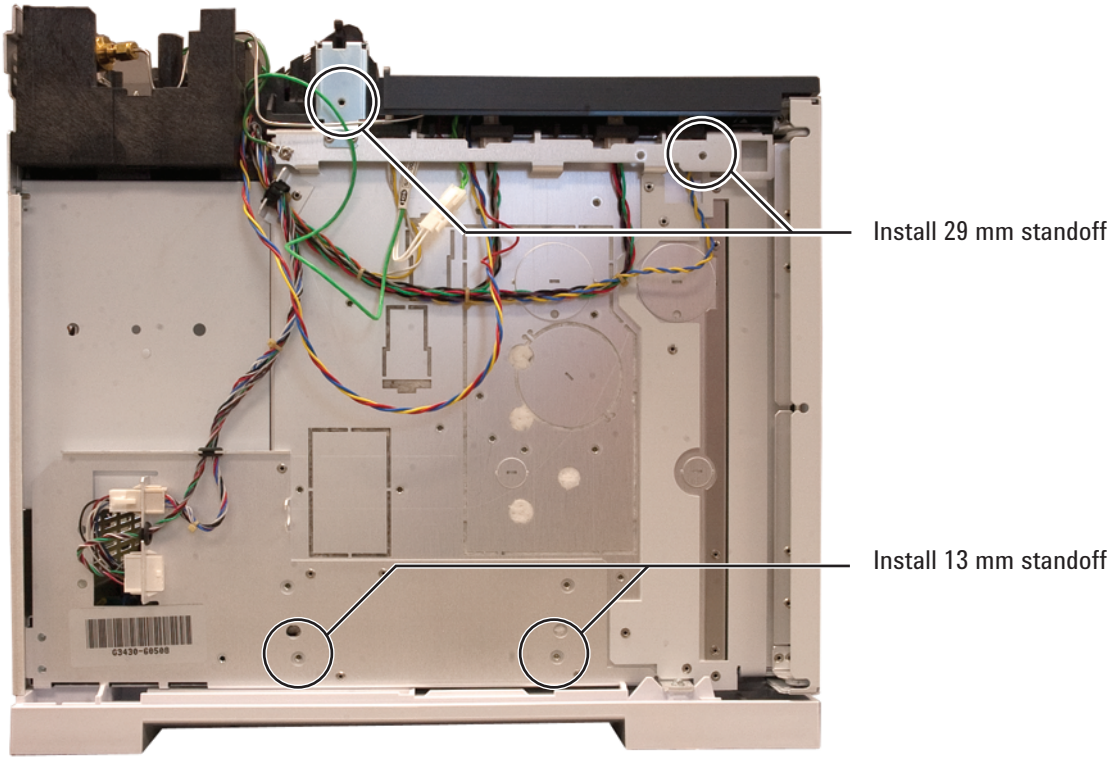


Figure 33 Installing the left side panel standoffs

5 Install the new metal side panel and secure in place with 4 M4 x 6 mm screws (0515-0684).
   - If a PAL autosampler is installed, instead use two 16 mm long flat head screws provided in the kit (0515-1034).

Remove the existing oven door

WARNING **Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear gloves to protect your hands.**

1 Cool all heated components of the GC to a safe handling temperature, including the oven, inlets, and detectors.

2 Turn off the GC and unplug the power cord.

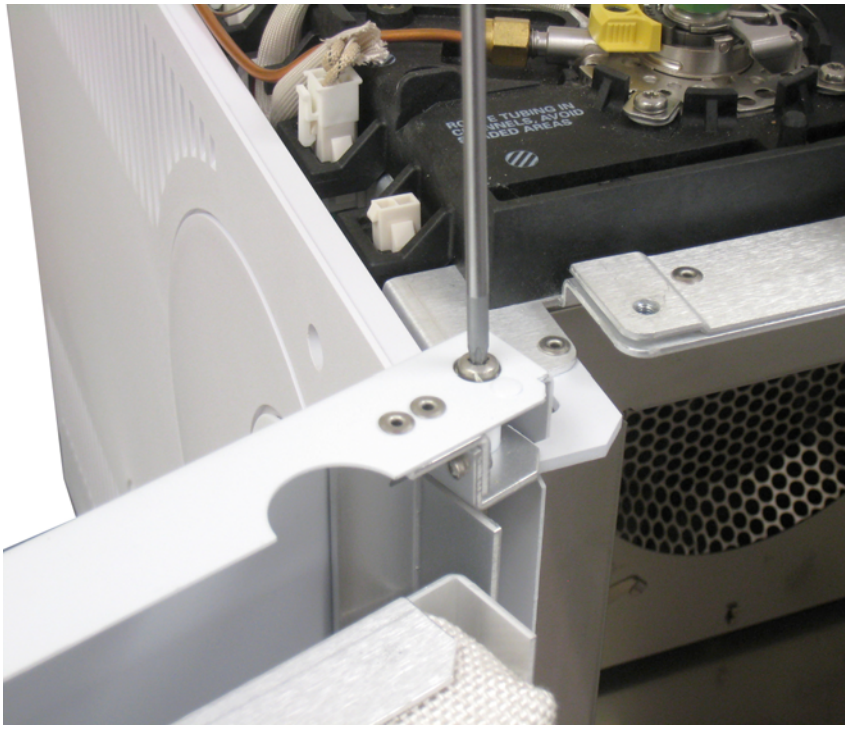
3 If an ALS or other sampler is installed, remove it. You need to access the inlet cover.

4 Remove the GC pneumatics cover and the top back panel.

5 Remove the six T-20 screws retaining the inlet cover, lift off and remove the cover.

6 Open the oven door. This exposes the top of the shaft that attaches the door to the GC.

7 The hinge shaft threads completely through its bracket, so that the threads cannot engage and loosen during use. To remove the shaft, use a flat-head screwdriver to lift the shaft from the bottom until it contacts the threads. Hold in place while using a T-20 driver to loosen the shaft. Turn the T-20 driver a few times to engage the threads on the bottom of the shaft with the top threaded plate of the bottom door hinge.



8 Use pliers to pull the door shaft up and out of the door while supporting the weight of the door.

9 Remove the door.

10 Carefully wrap the door and store it. (It can be stored in the shipping container for the LTM system.)

Install the LTM System

Install the LTM oven door

1 Position the LTM oven door in the GC hinge. Maintain a firm grip on the door.

Be careful not to tear or damage the fabric on the inner side of the door with any sharp edges or objects.

2 Use the original GC hinge bolt to attach the LTM oven door. Keep threading the hinge bolt until it passes completely through the door hardware, so that the screw threads drop below it. This retains the hinge bolt and prevents the door from accidentally working itself loose and disengaging from the mainframe (just as in the original door).

3 Reinstall the inlet cover.

Connect the power supply and communications cables

These instructions apply to systems with 1 electronics board. If installing a G6880A, make 2 sets of connections, one for each electronics board.

1 Open the electronics housing on the front of the LTM oven door. Turn the small knob counter-clockwise, then lower the door.

Observe how the mechanism for the latch knob works from the inside. When turning clockwise, the latch should flip upward and slowly engage to fasten the door closed. This should never be over tightened. If the mechanism has already been turned too far to close the door, turn it counterclockwise to open the latch adequately to clear the door.

2 Place the power supply next to the left side of the GC. Connect the plug cord to the power supply but do not connect it to mains voltage yet.

3 Route the LTM power cable through the side of the electronics cover and connect it to the electronics board at J1. See Figure 34 and Table 8.

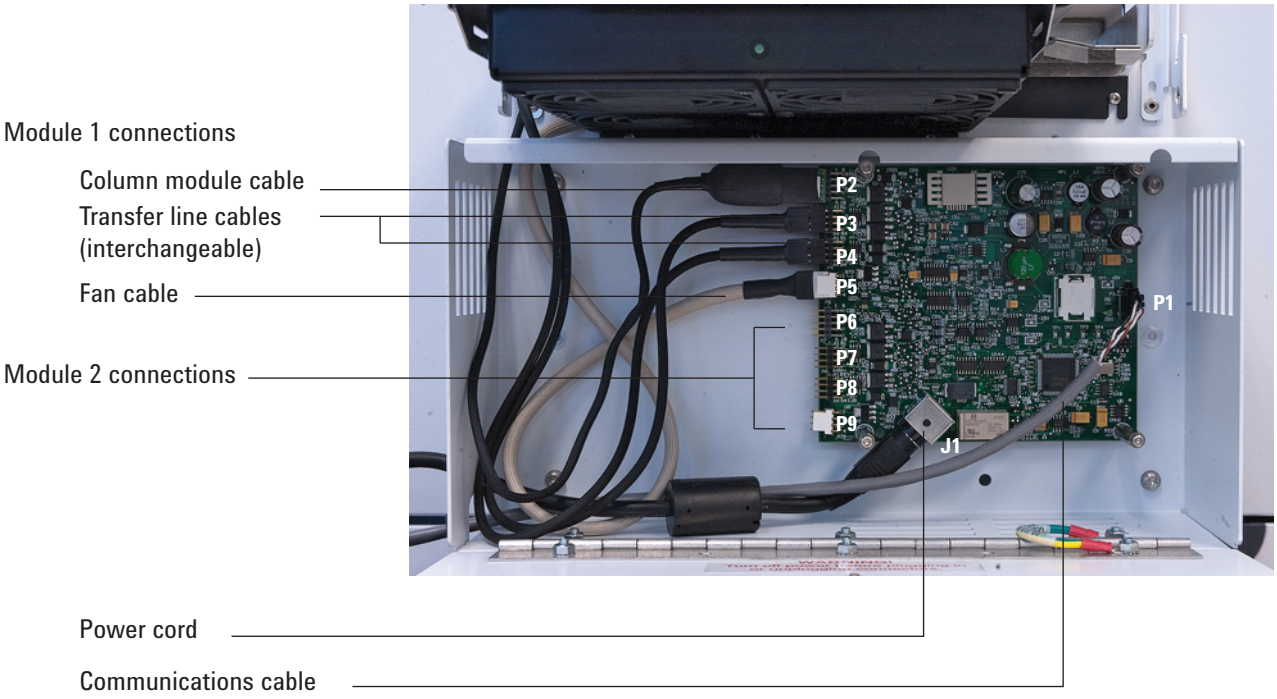


Figure 34 LTM electronics board cable connections

Table 8 Electronics board connectors

	Module 1	Module 2
Column module	P2	P6
Transfer lines	P3 and P4	P7 and P8
Fan cable	P5	P9
	Other connections	
Power cord	J1	
Communications cable	P1	

4 Route one end of the long gray communications cable through the left side of the electronics module as shown in Figure 34. Connect to the board at P1.

5 Route the other end of the communications cable around the left side of the GC. Route the cable up through the slot in the left GC panel next to the split vent trap compartment, behind the inlet fan.

6 Determine which communications connection to make:

Communications bus connector	Location
EPC6	In the pneumatics area for Aux EPC modules, right back corner of GC
AuxDet1	Left side of GC. To use this connector, remove the left side panel.
AuxDet2	Right side of GC, below detector electronics boards.

The matching connections on the GC are small 2-wire (one black wire, one red wire) connectors, each labeled with the connection name (**EPC6**, **AuxDet1**, and so forth). See Figure 35.

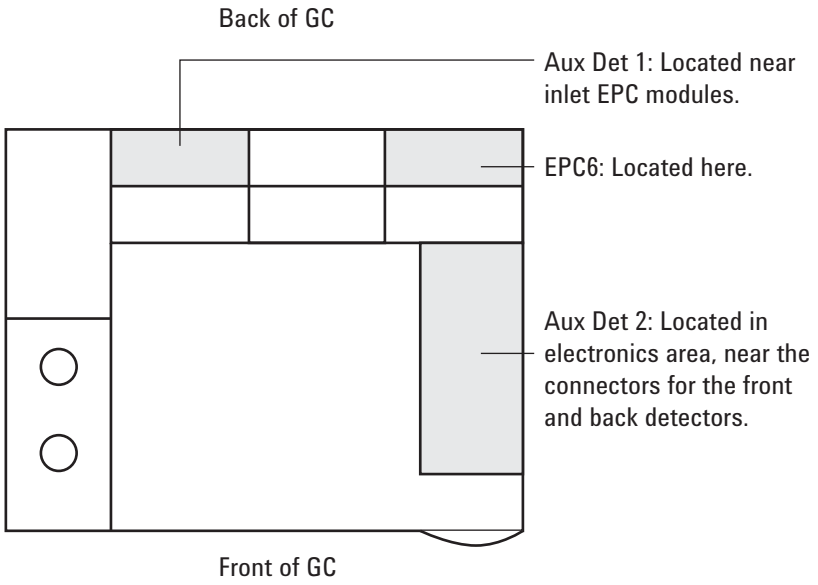


Figure 35 Locating the GC communications bus connections for LTM

7 Route the cable between the split vent traps (if installed) and across the GC, between the front and back inlet and detector EPC modules (if installed).

8 Connect the cable to the selected communications bus connector. If needed, route the cable down into the main GC electronics area (for an **AuxDet2** connection).

Install the fan module

Decide on which slot(s) to use for the position of your module(s). First consider inlet and detector locations in the GC oven. If using a detector in the top, front position, then using a lower slot in the door for the module will provide better clearance for the union and column ends.

1 Remove the slot cover using a T-10 Torx driver to remove the two screws. See Figure 36.

- For a 5-inch column module, remove *both* slot covers in the top or bottom row.

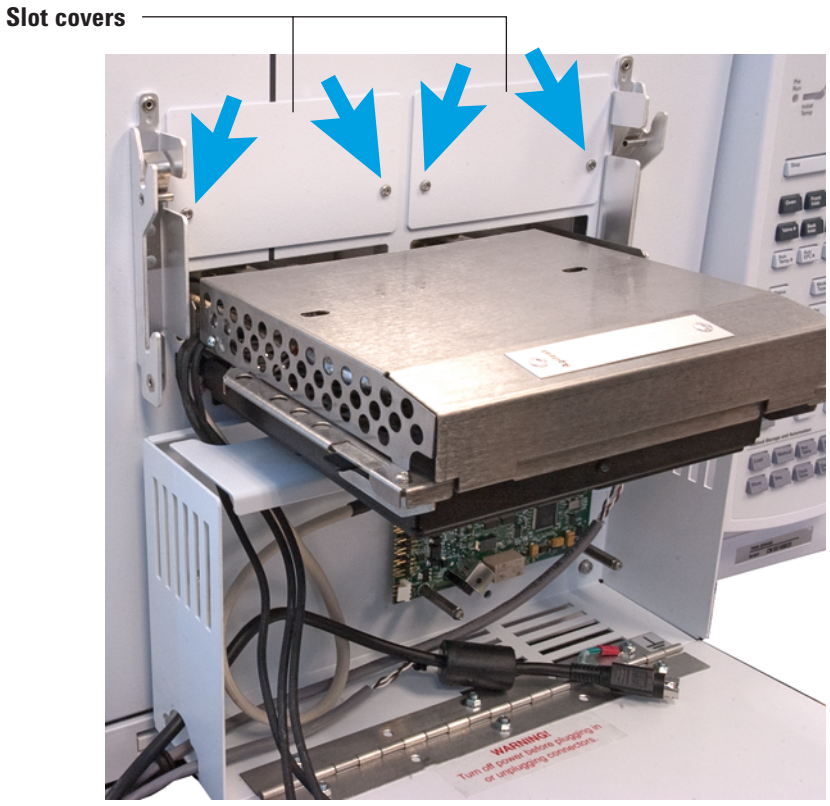


Figure 36 Slot covers. Two top slot covers shown above installed 5-inch column module.

2 Remove the insulation from the slot opening by gently pressing it out from the inside of the LTM oven door.

3 Seal the cover plate, insulation, and screws in a plastic bag or other sealed container. Retain in case you reconfigure the LTM system and need to close this slot.

4 Loosely install the 4 or 5 T-10 Torx screws that came with the fan assembly into the LTM oven door. See Figure 37.

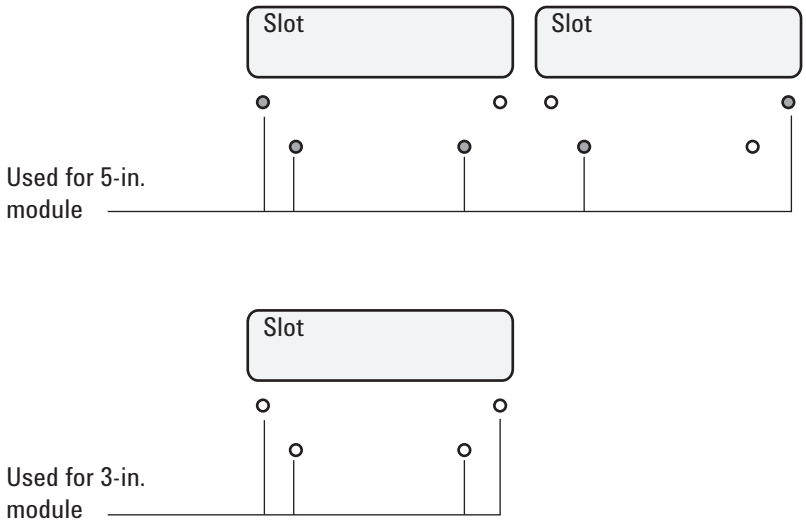


Figure 37 Fan bracket mounting screw locations

5 Place the fan assembly bracket over the mounting screws, then tighten the screws until snug. See Figure 38.

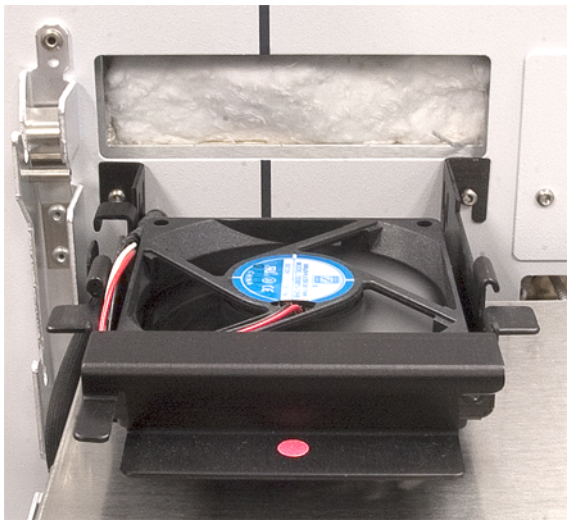
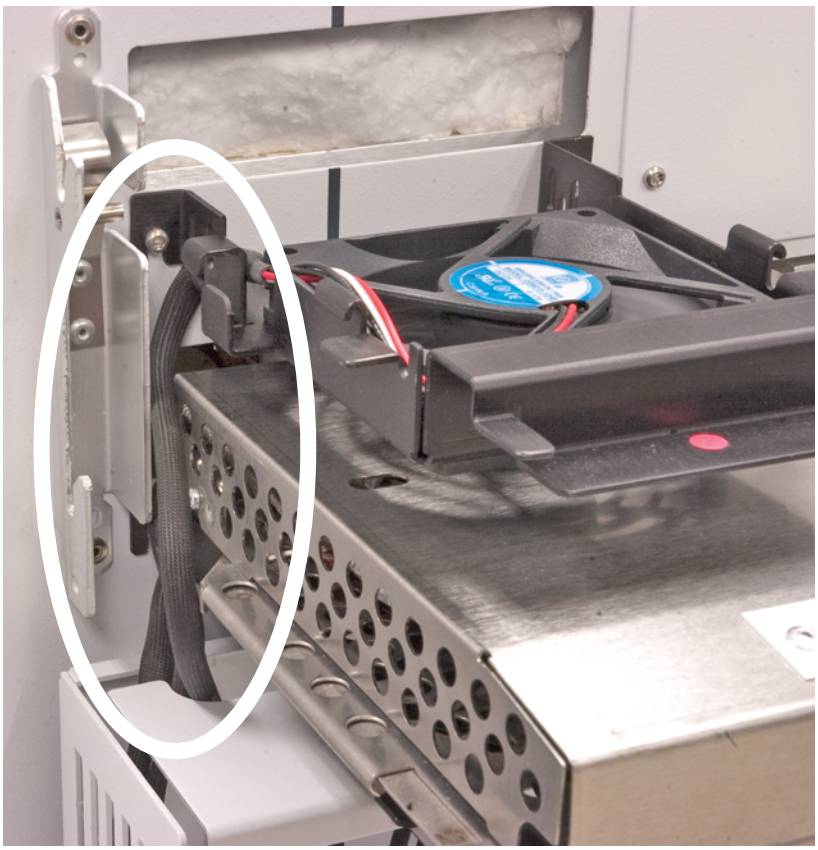


Figure 38 3-inch Fan module installed (shown with door slot insulation in place)

6 Route the fan cable through the slot and gap in the lower left of this bracket where it attaches to the door.



7 Connect the fan cable to the electronics board at P6 (or P9 for module 2). See Figure 34.

Install the LTM column modules

After installing the fan assembly, next install the selected column module. For instructions, see:

1 To Install an LTM Column Module onto a Transfer Line Module.

2 To Connect the Column to the CFT Unions.

3 To Install a Column Module Assembly in the LTM Oven Door.

Install the In and Out segments for each column module

After installing the LTM column module, install the In and Out column segments between the LTM column module and the GC inlet and detector. See "To Install an In or Out Segment to the Column Module Union".

Check the cable routing

Check the cable routing at the bottom left corner of the LTM oven door. Make sure that some slack is present so that the GC door can be opened at east halfway. If the cables are tight against the GC, the LTM oven door will not open properly.

If needed, install two plastic cable clamps to the metal left side panel. One installs near the LTM oven door, at the bottom front, and the other installs at the bottom, near the middle of the panel. See Figure 39.

Figure 39 Exterior cable routing (LTM system shown with covers re-installed)

Install the GC covers

Reinstall the GC covers.

Configure the LTM electronics boards

After installing the hardware, next configure the GC and columns.

First, connect the GC and LTM system to power and

configure the LTM system at the GC front panel.

1 If the system includes 2 electronics boards, Agilent recommends configuring one at a time. On the closest board, disconnect the communications cable from P1.

2 Plug in the LTM system power cord(s).

3 Plug in the GC power cord and turn on the GC.

4 Unlock the GC configuration controls. Press [**Options**], select **Keyboard & Display**, and press [**Enter**]. Scroll to **Hard Configuration Lock** and press [**Off/No**].

5 On the GC keypad, press [**Configure**] then scroll to **LTM II Col1 & Col2**. Press [**Enter**].

6 On the unconfigured parameter, press [**Mode/Type**].

7 Select **LTM II** as the type, then press [**Enter**].

8 Reboot the GC.

   a Press [**Options**].

   b Scroll to **Communications** and press [**Enter**].

   c Scroll to **Reboot the GC?** and press [**On/Yes**] twice to reboot the GC and have the changes take effect.

9 Check the GC status for fault messages. If an LTM system fault exists, check all cabling connections to the electronics board, then reboot.

10 If using 2 electronics boards, configure the second one.

   a Reconnect the communications cable to P1 on the second electronics board.

   b Reboot the GC.

   c Scroll to **LTM II Col3 & Col4**. Press [**Enter**]. (If needed, unlock the GC configuration controls.)

   d Press [**Mode/Type**].

   e Select **LTM II** as the type, then press [**Enter**].

   f Reboot the GC.

   g Check the GC status for fault messages. If an LTM system fault exists, check all cabling connections to the electronics board, then reboot.

11 Close the electronics enclosure on the LTM oven door.

12 Install the LTM top cover using two screws (one on each side of the cover).

Next, configure the columns used in the column module.

Configure the column modules

Configure each LTM column module in the GC as a composite column.

The 7890A GC can define all parts of the LTM column module columns as one “composite” column. In Figure 40, the In segment, analytical column, and Out segment are all part of a single defined GC column. By defining each segment of an LTM column, the 7890A GC can accurately control column flow even though the flow may pass through different id column material with differing film thicknesses.

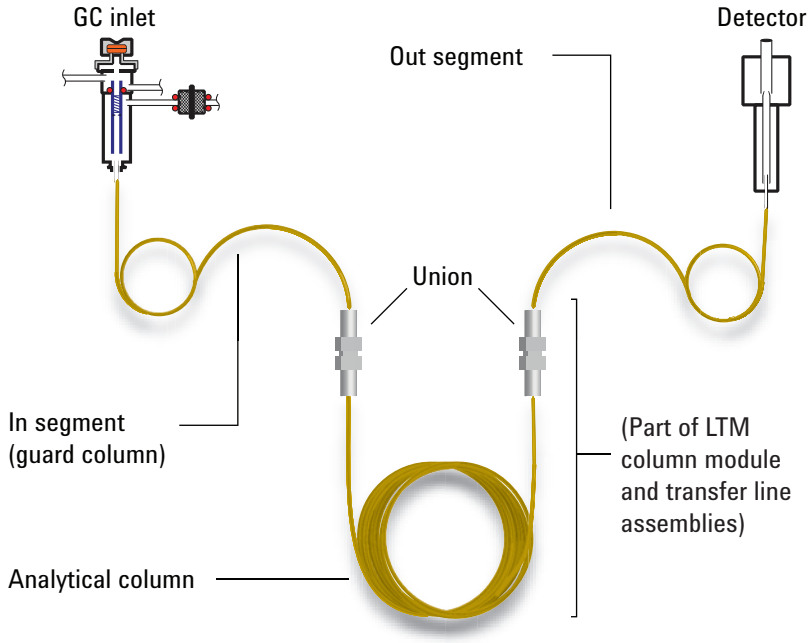


Figure 40 7890A GC Composite column parts

- For LTM Series II column modules, the GC will read primary LTM column dimensions (length, diameter, film thickness, module/column toroid size) and temperature limits from the LTM column module.
- Define the column that connects the GC inlet to the LTM column module as the **In Segment**.
- If using a Series I column module, define the LTM column as the primary column.
- Define the column that connects the detector to the column module as the **Out Segment**.
- If the column segment connected to the detector passes through a second heated zone, for example an MS transfer line, define the portion passing through the second zone as **Segment 2**.
- If using a Series I column module, set the **Module size** (**3 inch** or **5 inch**) for the whole column.

For details on configuring columns on the 7890A GC, see the 7890A GC *Advanced User Guide* (or the online help available from the data system's method editor).

Figure 41 shows the default GC column assignments for column modules connected to each board. (If the boards are configured differently than shown, the assignments change

accordingly.)

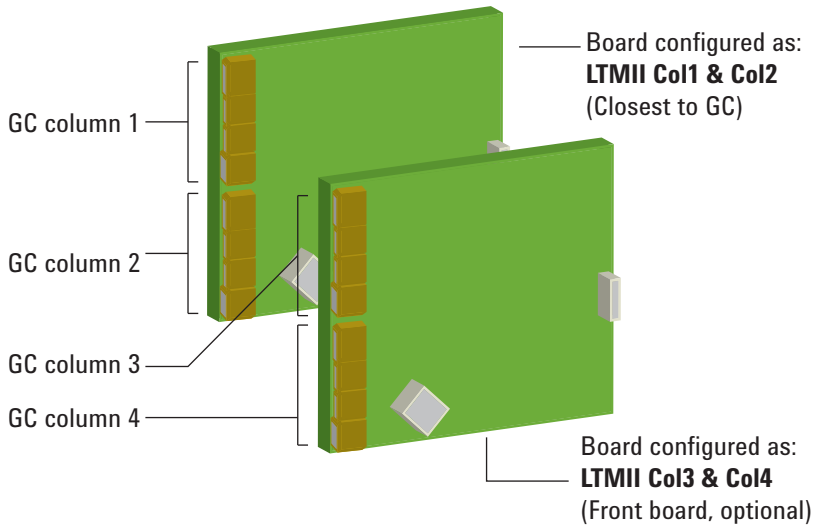


Figure 41 7890A GC column assignments by electronics board position

Check for leaks

The CFT fittings are generally leak-free once installed. If properly swaged, and if swaged and installed to the recommended tightness, these fittings can be thermally cycled, removed, and reinstalled many times without leaking. However, always check for leaks after making changes.

Turn on the GC inlet pressure. If the inlet does not hold pressure, check the connection between the GC column module and the CFT union first. Use an electronics leak checker to check for leaks at the new column connections.

Prepare the LTM system for use

Before using the LTM system, prepare it for use.

1. Establish a purge flow of carrier through the columns.
2. Purge the columns with carrier gas for at least 15 minutes.
3. Condition the columns according to the manufacturer's recommendations.
4. Run a standard or GC checkout sample as desired.